S

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 643812

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	Jim G. Field, Data Assessment and Interpretation, R2-12, 376-3756	[] Yes [X] No	07/29/98
	6. Project Title/No./Work Order No. Tank 241-SY-102	7. Bldg./Sys./Fac. No. 241-SY-102	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-366, Rev. 0-A	10. Related ECN No(s). ECN-612276	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change 13b. Design Baseline Document? [] Yes [X] No

The document has been totally revised to include the results of recent sampling to address technical issues associated with the waste, and to update the best basis standard inventory.

14a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

Changes required to incorporate new sampling data.

15. Distribution (include name, MSIN, and no. of copies)

See attached distribution.

RELEASE STAMP

DATE: AUG 28 1998 STA: 4 HANFORD RELEASE ID: 50

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) ECN-643812

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[ ] Yes	Additional	[ ] $	Additional	[ ] $	Improvement	[ ]
[X] No	Savings	[ ] $	Savings	[ ] $	Delay	[ ]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[ ]	Seismic/Stress Analysis	[ ]	Tank Calibration Manual	[ ]
Functional Design Criteria	[ ]	Stress/Design Report	[ ]	Health Physics Procedure	[ ]
Operating Specification	[ ]	Interface Control Drawing	[ ]	Spares Multiple Unit Listing	[ ]
Criticality Specification	[ ]	Calibration Procedure	[ ]	Test Procedures/Specification	[ ]
Conceptual Design Report	[ ]	Installation Procedure	[ ]	Component Index	[ ]
Equipment Spec.	[ ]	Maintenance Procedure	[ ]	ASME Coded Item	[ ]
Const. Spec.	[ ]	Engineering Procedure	[ ]	Human Factor Consideration	[ ]
Procurement Spec.	[ ]	Operating Instruction	[ ]	Computer Software	[ ]
Vendor Information	[ ]	Operating Procedure	[ ]	Electric Circuit Schedule	[ ]
OM Manual	[ ]	Operational Safety Requirement	[ ]	ICRS Procedure	[ ]
FSAR/SAR	[ ]	IEFD Drawing	[ ]	Process Control Manual/Plan	[ ]
Safety Equipment List	[ ]	Cell Arrangement Drawing	[ ]	Process Flow Chart	[ ]
Radiation Work Permit	[ ]	Essential Material Specification	[ ]	Purchase Requisition	[ ]
Environmental Impact Statement	[ ]	Fac. Proc. Samp. Schedule	[ ]	Tickler File	[ ]
Environmental Report	[ ]	Inspection Plan	[ ]		[ ]
Environmental Permit	[ ]	Inventory Adjustment Request	[ ]		[ ]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

Signature	Date	Signature	Date
Design Authority		Design Agent	
Cog. Eng. J.G. Field J.G. Field	8/6/98	PE	
Cog. Mgr. K.M. Hall Kathleen M. Hall	8/20/98	QA	
QA		Safety	
Safety		Design	
Environ.		Environ.	
Other J.W. Cammann J.W. Cammann	8/26/98	Other	
R.J. Cash R.J. Cash	8/26/98	DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
J.G. Kristofzski J.G. Kristofzski	8/26/98	ADDITIONAL	

Tank Characterization Report for Double-Shell Tank 241-SY-102

Jim G. Field
Lockheed Martin Hanford Corp., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: ECN-643812 UC: 2070
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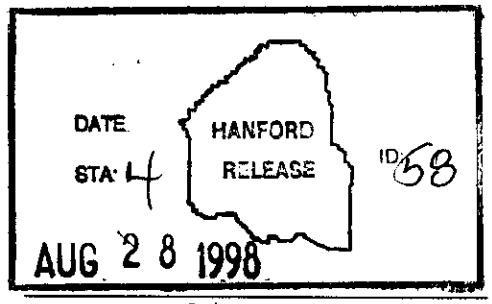
Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-SY-102. This report supports the requirements of the Tri-Party Agreement Milestone M-44-15B.



Release Approval 8/28/98 Date

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HNF-SD-WM-ER-366
Revision 1

Tank Characterization Report for Double-Shell Tank 241-SY-102

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LIST OF TERMS

AEA	alpha energy analysis
AES	atomic emission spectroscopy
ANOVA	analysis of variance
Btu/hr	British thermal units per hour
Ci/g	curies per gram
Ci/L	curies per liter
Ci	curie
CI	confidence interval
cm	centimeter
cm^2	square centimeter
cm^3	cubic centimeter
CMPO	octyl(phenyl)-N,N-diisobutylcarbamoyl methylphosphine oxide
DN	dilute noncomplexed liquid waste
DQO	data quality objective
DSC	differential scanning calorimetry
DW	decontamination waste
FDH	Fluor Daniel Hanford, Inc.
ft	feet
ft^2	square feet
g/mL	grams per milliliter
g/L	grams per liter
g/cc	grams per cubic centimeter
g	gram
GEA	gamma energy analysis
HDW	Hanford defined waste
HHF	hydrostatic head fluid
hr	hour
HTCE	historical tank content estimate
IC	ion chromatography
ICP	inductively coupled plasma spectroscopy
in.	inch
ISE	ion-selective electrode
J/g	joules per gram
kg	kilogram
kg/L	kilograms per liter
kgal	kilogallon
kL	kiloliter
kPa	kilopascal
kW	kilowatt
LEL	lower explosive limit

LIST OF TERMS (Continued)

LFL	lower flammability limit
LL	lower limit
m/s	meters per second
m	meter
M	moles per liter
mg	milligram
mL	milliliter
mm	millimeter
mmol/g	millimoles per gram
mRad/hr	millirads per hour
mrem	millirem
MS	mass spectroscopy
mSv	millisievert
n/r	not reported
n/a	not applicable
n/c	not corrected
N/R	not reviewed
N/A	not available
NPH	normal paraffin hydrocarbon
Pa	Pascal
Pa-s	Pascal-seconds
PFP	Plutonium Finishing Plant
PHMC	Project Hanford Management Contractor
PNNL	Pacific Northwest National Laboratory
ppm	parts per million
ppmv	parts per million by volume
psi	pounds per square inch
QC	quality control
REML	restricted maximum likelihood
RPD	relative percent difference
S2SltCk	S2 saltcake
SAP	sampling and analysis plan
SHMS	standard hydrogen monitoring system
SMM	supernatant mixing model
SpG	specific gravity
SU	supernatant
TCR	tank characterization report
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TLM	tank layer model
TOC	total organic carbon

LIST OF TERMS (Continued)

TRU	transuranic
TWRS	Tank Waste Remediation System
μg C/mL	micrograms carbon per milliliter
UL	upper limit
W	watt
W/Ci	watts per curie
WSTRS	Waste Status and Transaction Record Summary
wt%	weight percent
Z	Z plant
°C	degrees Celsius
°F	degrees Fahrenheit
%	percent
μCi/g	microcuries per gram
μCi/mL	microcuries per milliliter
μeg/g	microequivalents per gram
μg	microgram
μg C/g	micrograms carbon per gram
μg/g	micrograms per gram
μg/mL	micrograms per milliliter

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1.0 INTRODUCTION

A major function of the Tank Waste Remediation System (TWRS) is to characterize waste in support of waste management and disposal activities at the Hanford Site. Analytical data from sampling and analysis and other available information about a tank are compiled and maintained in a tank characterization report (TCR). This report and its appendices serve as the TCR for double-shell tank 241-SY-102. The objectives of this report are 1) to use characterization data in response to technical issues associated with tank 241-SY-102 waste, and 2) to provide a standard characterization of this waste in terms of a best-basis inventory estimate. Section 2.0 summarizes the response to technical issues, Section 3.0 shows the best-basis inventory estimate, and Section 4.0 makes recommendations about the safety status of the tank and additional sampling needs. The appendices contain supporting data and information. This report supports the requirements of *Hanford Federal Facility Agreement and Consent Order*, Milestone M-44-15b (Ecology et al. 1997), and change request M-44-97-03 to "issue characterization deliverables consistent with Waste Information Requirements Document developed for 1998".

1.1 SCOPE

The characterization information in this report originated from sample analyses and known historical sources. The results of recent sample events, summarized in Table 1-1, will be used to fulfill the requirements of the data quality objectives (DQOs) and memorandums of understanding specified in Brown et al. (1997) for this tank. Other information may be used to support conclusions derived from these results. Appendix A contains historical information for tank 241-SY-102 including surveillance information, records pertaining to waste transfers and tank operations, and expected tank contents derived from a process knowledge model. Appendix B summarizes recent sampling events and associated results and two historical core sampling events and associated results. Appendix C reports the statistical analysis and numerical manipulation of data used in issue resolution. Appendix D contains the evaluation to establish the best basis for the inventory estimate. Appendix E is a bibliography that resulted from an in-depth literature search of all known information sources applicable to tank 241-SY-102 and its respective waste types. The reports listed in Appendix E are available in the Lockheed Martin Hanford Corporation Tank Characterization and Safety Resource Center.

Table 1-1. Summary of Recent Sampling Events for Tank 241-SY-102.

Sample/Date[1]	Phase	Location	Segmentation	% Recovery
Grab (1/14/97)	Liquid/solid	Riser 1A	2 supernatant samples, 1 sludge sample	100%
Combustible gas test (7/23/97 - 8/14/97)	Gas	Tank headspace, Risers 17C and 23A, 6.1 m (20 ft) below top of riser	n/a	n/a
Push Core 211 (7/23/97 - 7/28/97)	Solid/liquid	Riser 23A	2 segments, upper half and lower half	79%
Push Core 213 (8/4/97 - 8/8/97)	Solid/liquid	Riser 17C	2 segments, upper half and lower half	72%
Grab (3/4/98 - 3/10/98)[2]	Liquid	Riser 1A	4 supernatant samples	100%

Notes:

n/a = not applicable

[1]Dates are in the mm/dd/yy format.

[2]Results from the March 1998 grab samples are not yet available.

1.2 TANK BACKGROUND

Tank 241-SY-102 is a double-shell tank located in the 200 West Area SY Tank Farm on the Hanford Site. The tank entered service in the second quarter of 1977; from that time until 1981, Agnew et al. (1997b) indicates the tank received mostly supernatant from the 241-S, -SX, -T, -TX, and -U tank farms. During this time, tank 241-SY-102 was also a feed tank for the 242-S Evaporator; output from the evaporator was routed to other 241-SY tanks, and to tanks in the 241-A, -S, -SX, and -U tank farms.

Since the last 242-S Evaporator campaign in 1980, tank 241-SY-102 received supernatant from other 200 West Area tanks and processes and was the staging tank for cross-site transfers to 200 East Area double-shell tanks. From the first quarter of 1981 to the second quarter of 1994, the tank received waste from the Plutonium Finishing Plant (PFP) laboratory and the 222-S Laboratory. From the first quarter of 1981 to the first quarter of 1990, the tank received decontamination waste from T Plant. From the first quarter of 1981 to the third

quarter of 1995, supernatant waste was transferred from tank 241-SY-102 to various 200 East Area double-shell tanks. From the fourth quarter of 1981 to the fourth quarter of 1983, the tank received salt well liquid from various 200 West Area single-shell tanks. From the second quarter of 1982 through the first quarter of 1992, tank 241-SY-102 received dilute noncomplexed waste from the PFP. In 1982 the tank received a single transfer of dilute noncomplexed liquid from the 300 and 400 Area laboratories.

From the second quarter of 1983 through the first quarter of 1988, tank 241-SY-102 received transuranic (TRU) waste from the PFP. These additions of TRU waste are likely the source of the TRU content now found in the sludge layer in tank 241-SY-102. In 1985, the tank received a single transfer of dilute phosphate waste from the 231-Z laboratories and salt well liquid from an unknown tank. In 1993, the tank again began receiving salt well liquid from 200 West Area single-shell tanks. For most of its history, the tank received flush water from miscellaneous sources. Transfer of waste to tank 241-SY-102 is and will continue to be an ongoing activity. From April 1997 through May 1998, the tank received a total of 300 kL (80 kgal) of salt well liquid and flush water in six transfers that ranged from 19 kL (5 kgal) to 76 kL (20 kgal). Agnew et al. (1997b) and Koreski (1998) summarize the background and waste transfer history of tank 241-SY-102.

Table 1-2 summarizes the description of tank 241-SY-102. The tank has a maximum storage capacity of 4,390 kL (1,160 kgal) and, as of March 31, 1998, contained an estimated 2,790 kL (737 kgal) of dilute noncomplexed waste and PFP transuranic waste (Hanlon 1998). The tank is not on the Watch List (Public Law 101-510).

Table 1-2. Description of Tank 241-SY-102.

TANK DESCRIPTION	
Type	Double shell
Constructed	1974 - 1976
In service	1977
Diameter	22.9 m (75.0 ft)
Operating depth	10.7 m (35.2 ft)
Capacity	4,390 kL (1,160 kgal)
Bottom shape	Flat
Ventilation	Active
TANK STATUS	
Waste classification	Dilute noncomplexed and PFP transuranic
Total waste volume	2,790 kL (737 kgal)
Supernatant volume[1]	2,520 kL (666 kgal)
Saltcake volume	0 kL (0 kgal)
Sludge volume[1]	270 kL (71 kgal)
Drainable interstitial liquid volume	0 kL (0 kgal)
Waste surface level (March 31, 1998)	681 cm (268 in.)
Temperature (April 1997 - March 1998)	9.4 °C (49.0 °F) to 22.8 °C (73.0 °F)
Integrity	Sound
Watch List	None
Flammable Gas Facility Group	Facility Group 2
SAMPLING DATES	
Grab samples	January 1997
Push mode core samples	July 1997
Grab samples	March 1998
SERVICE STATUS	
Active	

Note:

[1]Sludge volume estimate is from Appendix D of this TCR and differs from the Hanlon (1998) estimate of 333 kL (88 kgal); the supernatant volume has been adjusted upward from the Hanlon (1998) estimate by 64 kL (17 kgal) to maintain a total waste volume of 2,790 kL (737 kgal).

2.0 RESPONSE TO TECHNICAL ISSUES

The following technical issues have been identified for tank 241-SY-102 (Brown et al. 1997):

- **Safety screening**: Does the waste pose or contribute to any recognized potential safety problems?
- **Organic solvents**: Does an organic solvent pool exist that may cause a fire or ignition of organic solvents in entrained waste solids?
- **Compatibility**: Will safety problems be created as a result of commingling wastes in interim storage? Do operations issues exist that should be addressed before waste is transferred?
- **Pretreatment**: What fraction of the waste is soluble when treated by sludge washing and leaching?
- **Privatization**: Do the samples taken from tank 241-SY-102 and the subsequent laboratory analysis meet the needs of the privatization low-activity waste DQO (Jones and Wiemers 1996)?

Two sampling and analysis plans (SAPs), the *Compatibility Grab Sampling and Analysis Plan for Fiscal Year 1997* (Sasaki 1997a) and the *Tank 241-SY-102 Push Mode Core Sampling and Analysis Plan* (Sasaki 1997b), specified the types of sampling and analysis needed to address the above issues. Data from the analysis of supernatant grab samples, push mode core samples, and tank headspace measurements, along with available historical information, provided the input to respond to the technical issues. Sections 2.1 through 2.6 present the response, and Appendix B discusses the sample and analysis data for tank 241-SY-102.

The sampling and analysis events for tank 241-SY-102 were conducted to address the technical issues identified in Revision 3 of the *Tank Characterization Technical Sampling Basis* (Brown et al. 1997). The remainder of Section 2.0 discusses only those technical issues identified in Revision 3 of the technical sampling basis. Since the sampling and analysis of tank 241-SY-102, Revision 4 of the technical sampling basis (Brown et al. 1998) has been issued. Revision 4 removes the privatization issue and identifies the additional issues of vapor phase sampling and regulatory air emissions. Revision 4 issues are briefly discussed in Section 2.6.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-SY-102 for potential safety problems are documented in the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995).

These potential safety problems are exothermic conditions in the waste, flammable gases in the waste and/or tank headspace, and criticality conditions in the waste. Each condition is addressed separately below.

2.1.1 Exothermic Conditions (Energetics)

The first requirement outlined in the safety screening DQO (Dukelow et al. 1995) is to ensure that there are not sufficient exothermic constituents (organic or ferrocyanide) in tank 241-SY-102 to pose a safety hazard. Because of this requirement, energetics in tank 241-SY-102 waste were evaluated. The safety screening DQO required that the waste sample profile be tested for energetics every 24 cm (9.5 in.) to determine whether the energetics exceeded the safety threshold limit. The threshold limit for energetics is 480 J/g on a dry-weight basis. Results obtained using differential scanning calorimetry (DSC) indicated no exotherms in any of the 1997 core or grab samples.

2.1.2 Flammable Gas

Flammable gas measurements were taken in the tank 241-SY-102 headspace through risers 23A and 17C during the July/August 1997 core sampling effort. Tank headspace flammability ranged between 0 and 1 percent of the lower flammability limit (LFL); this is well below the safety screening limit of 25 percent of the LFL. In addition, the tank is equipped with a standard hydrogen monitoring system (SHMS) to continuously measure the hydrogen in the headspace. Data from the SHMS are discussed in Appendix B.

2.1.3 Criticality

The safety screening DQO threshold for criticality, based on the total alpha activity, is 1 g/L. Because total alpha activity in solid samples is measured in μCi/g instead of g/L, the 1 g/L limit is converted into units of μCi/g by assuming that all alpha activity originates from ^{239}Pu. Assuming that all alpha activity is from ^{239}Pu and for a maximum sample density of 1.64 g/mL, 1 g/L of ^{239}Pu is equivalent to 37.5 μCi/g of alpha activity or 610 μg/g ^{239}Pu.

For the total alpha activity data, core 211, segment 11, lower half, had a mean total alpha activity value of 91 μCi/g with a maximum upper bound of the 95 percent confidence interval of 103 μCi/g. Both values exceeded the threshold limit of 37.5 μCi/g. However, the majority of this alpha activity was due to ^{241}Am. The ^{241}Am mean activity for core 211, segment 11 was 99.6 μCi/g. For the same sample, the $^{239/240}$Pu mean activity (as determined by alpha counting) was 26.8 μCi/g, and the upper bound of the 95 percent confidence interval for $^{239/240}$Pu was 31.2 μCi/g; both values are less than the computed 37.5 μCi/g threshold limit. Also for the same sample, the upper bound of the 95 percent confidence interval for inductively coupled plasma/mass spectroscopy (ICP/MS) ^{239}Pu was 247 μg/g; this value is less

than the computed 610 μg/g ^{239}Pu threshold limit. In summary, while one sample exceeded the computed total alpha activity threshold, the safety screening thresholds were not exceeded based on actual plutonium values. Appendix C contains the method used to calculate confidence limits.

For the supernatant, the safety screening DQO threshold 1 g/L converts to 62 μCi/mL ^{239}Pu. The largest mean plutonium activity was 1.52E-05 μCi/mL $^{239/240}$Pu for the January 1997 supernatant grab sample 2SY-96-2. This is well below the safety screening DQO threshold value.

2.2 ORGANIC SOLVENTS SAFETY SCREENING

The data required to support the organic solvent screening issue are documented in the *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue* (Meacham et al. 1997). The DQO requires tank headspace samples be analyzed for total nonmethane organic compounds to determine whether the organic extractant pool in the tank is a hazard. The purpose of this assessment is to ensure that an organic solvent pool fire or ignition of organic solvents cannot occur.

No vapor samples have been taken to estimate the organic pool size. However, the organic program has determined that even if an organic solvent pool does exist, the consequence of a fire or ignition of organic solvents is below risk evaluation guidelines for all of the tanks (Brown et al. 1998). Consequently, vapor samples are not required for this tank. The organic solvent issue is expected to be resolved for all tanks in fiscal year 1998.

2.3 COMPATIBILITY

Double-shell tank 241-SY-102 is the receiver tank for process water and salt-well-pumped supernatant from West Area single-shell tanks. Therefore, a waste compatibility sample of the supernatant was obtained from tank 241-SY-102 to ensure that supernatant waste from the single-shell tanks is compatible with the waste in tank 241-SY-102. The sampling and analysis plan (Sasaki 1997a) specified that sampling and analysis of the tank 241-SY-102 grab samples be performed to the requirements of the *Data Quality Objectives for the Tank Farms Waste Compatibility Program* (Fowler 1995).

Fowler (1997) reports the waste compatibility assessment for tank 241-SY-102 for the January 14, 1997, grab samples. All safety and operations waste compatibility criteria were met for tank 241-SY-102. The safety criteria encompassed criticality, flammable gas, energetics, corrosivity, and chemical compatibility. The operations criteria consisted of tank waste type, transuranic waste segregation, heat generation, complexant waste segregation, and phosphate waste.

The *Compatibility Grab Sampling and Analysis Plan for Fiscal Year 1997* (Sasaki 1997) governed the January 1997 grab sampling and analysis. This SAP incorporated the sampling and analysis requirements of Revision 1 of the waste compatability DQO (Fowler 1995). Since the January 1997 grab sampling event, Revision 2 of the compatibility DQO (Mulkey and Miller 1997) has been issued. Additional waste compatibility grab samples were acquired from tank 241-SY-102 in March 1998 to meet the requirements of Revision 2 of the compatibility DQO. The results from the March 1998 samples were not available in time to include in this TCR.

2.4 PRETREATMENT

Samples from the July/August push mode core sampling of tank 241-SY-102 were archived for future pretreatment analyses and evaluation in accordance with the *Strategy for Sampling Hanford Site Tanks for Development of Disposal Technology* (Kupfer et al. 1995).

2.5 PRIVATIZATION

Tank 241-SY-102 is within the scope of the privatization low-activity waste DQO (Jones and Wiemers 1996). The purpose of the low-activity waste DQO is to address technical issues pertinent to pretreatment, immobilization, and balance-of-plant for low-activity waste processing. Waste will be characterized to determine whether it falls within the defined process design envelope. Data collected in support of this DQO will be used primarily for planning activities of TWRS privatization contractors as specified in the privatization request for proposals.

Samples from the July/August push mode core sampling of tank 241-SY-102 were archived for future privatization analyses and evaluation.

2.6 OTHER TECHNICAL ISSUES

This section discusses technical and safety issues not covered in Sections 2.1 through 2.5. Section 2.6.1 addresses the heat load caused by radioactive decay in the tank waste. Section 2.6.2 discusses other recently identified technical issues.

2.6.1 Tank Waste Heat Load

A factor in assessing tank safety is the heat generation of the waste. Heat is generated in the tanks from radioactive decay. Table 2-1 shows an estimate of 979 W (3,340 Btu/hr) for the tank 241-SY-102 heat load based on the best-basis inventory of the radionuclides in the tank (see Section 3.0 and Appendix D of this TCR). Agnew et al. (1997a) estimate the heat load as

516 W (1,760 Btu/hr) based on the Hanford defined waste (HDW) model. Kummerer (1995) presents a heat load estimate of 586 W (2,000 Btu/hr) based on the tank radionuclide content. All these estimates are well below the operational limit of 14,700 W (50,000 Btu/hr) for the SY Farm tanks (Cox 1997).

Table 2-1. Radionuclide Decay Heat Load in Tank 241-SY-102.

Radionuclide	Inventory[1]	Decay Heat[2]	Heat Load	
	Ci	W/Ci	W	Btu/hr
^{60}Co	50	0.0154	1	3
^{90}Sr	34,700	0.00669 [3]	232	792
^{137}Cs	53,600	0.00472 [4]	253	863
^{154}Eu	536	0.00898	5	16
^{238}Pu	303	0.0326	10	34
^{239}Pu	2,340	0.0305	71	243
^{240}Pu	894	0.0306	27	93
^{241}Am	11,600	0.0328	379	1,300
^{244}Cm	22.1	0.0344	1	3
Totals			979	3,340

Notes:

[1]From best-basis inventory values for radionuclides in Table 3-2. Inventory values are based on a sludge volume of 270 kL (71 kgal), a supernatant volume of 1,080 kL (287 kgal), and are decay corrected to January 1, 1994.

[2]Decay heat values are from Kirkpatrick and Brown (1984).

[3]Accounts for $^{90}Sr/^{90}Y$.

[4]Accounts for $^{137}Cs/^{137}Ba$.

2.6.2 Technical Sampling Basis Revision 4 Issues

The sampling and analysis events for tank 241-SY-102 were conducted to address the technical issues identified in Revision 3 of the *Tank Characterization Technical Sampling Basis* (Brown et al. 1997). Since the sampling and analysis of tank 241-SY-102, Revision 4 of the technical sampling basis (Brown et al. 1998) has been issued. For tank 241-SY-102, Revision 4 removes the privatization issue and identifies the additional issues of vapor phase sampling and regulatory air emissions.

The vapor phase sampling and analysis supports resolution of flammable gas issues. To help resolve flammable gas issues, tank 241-SY-102 is equipped with a standard hydrogen monitoring system for the collection of vapor phase data; these data are discussed in Section B2.3.2.

The *Data Quality Objective for Regulatory Requirements for Hazardous and Radioactive Air Emissions Sampling and Analysis* (Mulkey and Markillie 1995) sets requirements for sampling and analysis to support the regulatory air emissions issue. The regulatory air-emissions DQO requires vapor samples and a surface-level grab sample of the waste. Sampling and analysis to support this issue have yet to be performed.

2.7 SUMMARY

The results of all analyses performed to address potential safety issues showed that primary analytes did not exceed safety decision threshold limits. One sample from the July/August 1997 push mode core sampling exceeded the total alpha activity threshold; however, the safety screening thresholds were not exceeded based on actual plutonium values. The level of transuranic species in the tank 241-SY-102 sludge layer is consistent with the transfer history of the tank that includes transuranic-bearing waste from the PFP. The results needed to resolve the technical issues for tank 241-SY-102 are summarized in Table 2-2.

Table 2-2. Summary of Technical Issues for Tank 241-SY-102.

Issue	Sub-issue	Result
Safety screening	Energetics	No exotherms observed in 1997 grab or core samples.
	Flammable gas	Vapor measurement reported 0 to 1 percent of LFL (combustible gas meter).
	Criticality	Core 211, segment 11, lower half exceeded total alpha threshold value of 37.5 μCi/g; actual plutonium values did not exceed threshold value at the 95 percent confidence limit.
Organic solvents[1]	Solvent pool size	Organic solvents were not evaluated for this tank.
Compatibility	Safety (criticality, flammable gas, energetics, corrosivity, chemical compatibility)	All compatibility criteria were met.
	Operations (tank waste type, transuranic waste segregation, heat generation, complexant waste segregation, phosphate waste)	
Pretreatment	Analyses for treatment to separate low-level and high-level waste streams	Samples were archived for future analysis.
Privatization	Low-activity waste	Sample results were submitted to privatization program for evaluation.

Note:

[1]The organic solvents safety issue is expected to be closed in fiscal year 1998.

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3.0 BEST-BASIS STANDARD INVENTORY ESTIMATE

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing them into a form that is suitable for long-term storage.

Chemical and radiological inventory information is generally derived using three approaches: 1) component inventories are estimated using the results of sample analyses; 2) component inventories are predicted using the HDW model (Agnew et al. 1997a) based on process knowledge and historical information; or 3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data.

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-SY-102 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task; Appendix D contains details of the evaluation. The following information was used in the evaluation:

- Sludge-weight measurements, core sample recoveries, and grab-sample sludge recoveries to estimate the volume of the sludge layer
- Analytical results from February/March 1990 and July/August 1997 push mode core samples
- Analytical results from a January 14, 1997, grab sample
- Waste component concentration estimates generated by the HDW model for tank 241-SY-102 (Agnew et al. 1997a).

Based on this evaluation, a best-basis inventory was developed for tank 241-SY-102. The sampling-based inventory was chosen as the best basis for those analytes for which analytical values were available. The HDW model results were used if no sample-based information was available. The inventory was calculated based on a sludge volume of 270 kL (71 kgal) and a static supernatant volume of 1,080 kL (287 kgal) for a total static waste volume of 1,350 kL (358 kgal). Because tank 241-SY-102 routinely receives wastes from the 200 West Area operations and serves as the staging tank for cross-site transfers to the 200 East Area double-shell tank farms, the liquid volume in this tank frequently changes. Therefore, the supernatant volume of 1,080 kL was adopted to represent the static supernatant layer below the

current administrative minimum of 330 cm (130 in.) for the tank waste (LMHC 1998). (In contrast to the 1,080 kL supernatant volume used in the best-basis analysis, the total volume of tank supernatant was approximately 2,520 kL [666 kgal] as of March 31, 1998.) To calculate the solids contribution to the best-basis inventory, a solids density of 1.44 g/mL was used; this is the mean value for the July/August 1997 push mode core samples (see Appendix B, Table B2-120).

Best-basis tank inventory values were determined for 25 key chemical species. The best-basis values for mercury were set to zero as specified in Simpson (1998). Once the best-basis inventories were determined for 24 of the species, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997a).

Best-basis tank inventory values were also derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decay corrected to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}Pu$, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, ^{241}Am have been infrequently reported. For this reason, it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1, and in Watrous and Wootan 1997.) Model-generated values for radionuclides in any of the 177 Hanford Site tanks are reported in Agnew et al. (1997a). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result, if available.

The best-basis inventory estimate for tank 241-SY-102 is presented in Tables 3-1 and 3-2. These inventory values are subject to change. Refer to the Tank Characterization Database for the most current inventory values.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-SY-102 (Effective March 31, 1998). (2 sheets)

Analyte	Static Waste Inventory[1] (kg)	Basis (S, M, E, or C)	Comment[2]
Al	18,500	S	
Bi	495	S/E	Supernatant inventory estimated to be zero
Ca	788	S/E	Supernatant inventory bounded by method detection limit
Cl	2,170	S	

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-SY-102 (Effective March 31, 1998). (2 sheets)

Analyte	Static Waste Inventory[1] (kg)	Basis (S, M, E, or C)	Comment[2]
TIC as CO_3	18,900	S/E	Based on 1990 core sample results
Cr	5,820	S	
F	1,310	S	
Fe	5,110	S/E	Supernatant inventory estimated to be zero
Hg	0.00	E	Simpson (1998)
K	2,810	S	
La	31.4	S/E	Supernatant inventory estimated to be zero
Mn	1,700	S/E	Supernatant inventory estimated to be zero
Na	81,700	S	
Ni	73.5	S/E	Supernatant inventory estimated to be zero
NO_2	28,400	S	
NO_3	93,300	S	
OH_{Total}	45,900	C	
Pb	391	S/E	Supernatant inventory estimated to be zero
PO_4	16,100	S	
Si	499	S	
SO_4	4,380	S	
Sr	22.2	S/E/M	
TOC	4,070	S/E	Solids TOC estimated from 1997 core sample oxalate results
U_{Total}	551	S/E/M	Solids uranium content based on 1997 core sample ICP/MS data
Zr	29.1	S/E	Supernatant inventory estimated to be zero

Notes:

S = Sample-based (see Appendix B), M = HDW model-based, Agnew et al. (1997a), E = Engineering assessment-based, C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

[1]Based on a sludge volume of 270 kL (71 kgal) and a static supernatant volume of 1,080 kL (287 kgal).

[2]Sample-based values are from January 1997 grab sample 2SY-96-2 and the July/August 1997 core samples, unless otherwise noted.

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-SY-102 Decay Corrected to January 1, 1994 (Effective March 31, 1998). (3 sheets)

Analyte	Static Waste Inventory[1] (Ci)	Basis (S, M, or E)	Comment[2]
^{3}H	0.343	S/E/M	Based on 1990 core sample results
^{14}C	1.23	S/E/M	Based on 1990 core sample results
^{59}Ni	0.129	M/E	
^{60}Co	50.0	S/E/M	Based on 1990 core sample results
^{63}Ni	12.7	M/E	
^{79}Se	0.477	M/E	
^{90}Sr	34,700	S/E	Based on 1990 core sample results
^{90}Y	34,700	S/E	^{90}Y assumed equal to ^{90}Sr
^{93}Zr	2.35	M/E	
^{93m}Nb	1.71	M/E	
^{99}Tc	23.7	S/E/M	Based on 1990 core sample results
^{106}Ru	9.05E-04	M/E	
^{113m}Cd	12.1	M/E	
^{125}Sb	23.6	M/E	
^{126}Sn	0.726	M/E	
^{129}I	0.129	M/E	
^{134}Cs	0.699	M/E	
^{137}Cs	53,600	S/E	Based on 1990 core sample results
^{137m}Ba	50,700	S/E	Based on 0.946 of ^{137}Cs activity
^{151}Sm	1,690	M/E	
^{152}Eu	0.582	M/E	
^{154}Eu	536	S/E/M	Based on 1990 core sample results
^{155}Eu	485	S/E/M	Based on 1990 core sample results
^{226}Ra	2.14E-05	M/E	
^{227}Ac	1.32E-04	M/E	
^{228}Ra	0.0153	M/E	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-SY-102 Decay Corrected to January 1, 1994 (Effective March 31, 1998). (3 sheets)

Analyte	Static Waste Inventory[1] (Ci)	Basis (S, M, or E)	Comment[2]
^{229}Th	3.71E-04	M/E	
^{231}Pa	5.90E-04	M/E	
^{232}Th	0.0180	S/E/M	Solids value based on ICP-MS data
^{232}U	0.0902	S/E/M	Based on uranium sample result ratioed to HDW estimates for U isotopes
^{233}U	3.22	S/E/M	Solids value based on ICP/MS data
^{234}U	0.194	S/E/M	Based on uranium sample result ratioed to HDW estimates for U isotopes
^{235}U	0.0100	S/E/M	Solids value based on ICP/MS data
^{236}U	0.0112	S/E/M	Solids value based on ICP/MS data
^{237}Np	0.420	S/E/M	Solids value based on ICP/MS data
^{238}U	0.184	S/E/M	Solids value based on ICP/MS data
^{238}Pu	303	S/E/M	Based on 1990 core sample results
^{239}Pu	2,340	S/E/M	Solids value based on alpha & ICP/MS data; supernatant value based on $^{239/240}$Pu value and HDW estimates for Pu isotopes
^{240}Pu	894	S/E/M	Solids value based on alpha & ICP/MS data; supernatant value based on $^{239/240}$Pu value and HDW estimates for Pu isotopes
^{241}Pu	8.98	S/E/M	Based on $^{239/240}$Pu value and HDW estimates for Pu isotopes
^{241}Am	11,600	S/E	Sample-based ^{241}Am determinations
^{242}Pu	0.268	S/E/M	Solids value based on ICP/MS data; supernatant value based on $^{239/240}$Pu value and HDW estimates for Pu isotopes
^{242}Cm	2.55E-04	S/E/M	^{214}Am results times HDW estimate of ^{242}Cm/^{241}Am

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-SY-102 Decay Corrected to January 1, 1994 (Effective March 31, 1998). (3 sheets)

Analyte	Static Waste Inventory[1] (Ci)	Basis (S, M, or E)	Comment[2]
^{243}Am	0.00279	S/E/M	Based on ^{241}Am values ratioed to HDW estimates for Am isotopes
^{243}Cm	0.960	S/E/M	Based on 1990 core sample results; ^{243}Cm inventory equals 0.04 times $^{243/244}Cm$ inventory
^{244}Cm	22.1	S/E/M	Based on 1990 core sample results; ^{244}Cm inventory equals 0.96 times $^{243/244}Cm$ inventory

Notes:

S = Sample-based (see Appendix B), M = HDW model-based, Agnew et al. (1997a), E = Engineering assessment-based

[1]Based on a sludge volume of 270 kL (71 kgal) and a static supernatant volume of 1,080 kL (287 kgal).

[2]Sample-based values are from January 1997 grab sample 2SY-96-2 and the July/August 1998 core samples, unless otherwise noted.

4.0 RECOMMENDATIONS

For the July/August 1997 core samples, results from the safety screening analyses revealed one subsample with a total alpha activity in excess of the safety screening threshold. However, the majority of this activity was from ^{241}Am, and for the same sample, neither the mean value nor the upper 95 percent one-sided confidence limit of the ^{239}Pu activity exceeded the safety screening threshold. All other July/August 1997 core sample analytical results were well within the notification limits for the safety screening DQO (Dukelow et al. 1995). Therefore, the sampling and analysis activities performed for tank 241-SY-102 have met all requirements for the safety screening DQO. Analytical results for the January 14, 1997, grab samples showed that all waste compatibility criteria were met. Vapor samples have not been taken to resolve the organic solvent safety DQO (Meacham et al. 1997). However, the organic solvent issue is expected to be closed for all tanks in fiscal year 1998, and no additional vapor sampling is planned for tank 241-SY-102. Samples from the July/August 1997 core sampling were archived for future analyses to support the pretreatment and privatization issues.

Table 4-1 summarizes the Project Hanford Management Contractor (PHMC) TWRS Program review status and acceptance of the sampling and analysis results reported in this TCR. All issues required to be addressed by sampling and analysis are listed in column 1 of Table 4-1. Column 2 indicates by "yes" or "no" whether issue requirements were met by the sampling and analysis performed. Column 3 indicates concurrence and acceptance by the program in PHMC/TWRS that is responsible for the applicable issue. A "yes" in column 3 indicates that no additional sampling or analyses are needed. Conversely, "no" indicates additional sampling or analysis may be needed to satisfy issue requirements.

Table 4-1 indicates that several issues remain unresolved for tank 241-SY-102. The organic solvent issue remains unresolved because total nonmethane organic compound concentrations have not been determined for any of the double-shell tanks; hence, no data are available to estimate the organic solvent pool size. However, the organic solvent issue is expected to be resolved for all tanks in fiscal year 1998. For the pretreatment and privatization issues, push mode core sampling of the sludge layer was performed, and samples were archived for future analysis. Analytical results from the archived samples are not yet available to resolve the pretreatment and privatization issues. Revision 4 of the *Tank Characterization Technical Sampling Basis* (Brown et al. 1998) does not include privatization as an issue for tank 241-SY-102.

Table 4-1. Acceptance of Tank 241-SY-102 Sampling and Analysis.

Issue	Sampling and Analysis Performed	Program[1] Acceptance
Safety screening DQO	Yes	Yes
Organic solvents DQO[2]	No	n/a
Waste compatibility DQO	Yes	Yes
Pretreatment DQO	No	N/R
Privatization DQO	No	N/R

Notes:

N/R = not reviewed

[1]PHMC TWRS Program Office

[2]The organic solvents issue is expected to be closed in fiscal year 1998.

Table 4-2 summarizes the status of PHMC TWRS Program review and acceptance of the evaluations and other characterization information contained in this report. Column 1 lists the different evaluations performed in this report. Column 2 shows whether issue evaluations have been completed or are in progress. Column 3 indicates concurrence and acceptance with the evaluation by the program in PHMC/TWRS that is responsible for the applicable issue. A "yes" indicates that the evaluation is complete and meets all issue requirements.

Table 4-2 indicates that several issues remain unresolved for tank 241-SY-102. The reasons these issues are unresolved are discussed in conjunction with Table 4-1.

Based on the analysis of the tank safety screening data, the safety categorization of the tank is listed as "safe." However, the total plutonium loading of 41.7 kg (best-basis estimate) in the sludge layer in the tank is sufficiently high that criticality should continue to be a concern during waste transfers to and from the tank. To avoid disturbing the sludge layer in the tank, continuing the existing administrative control of maintaining a minimum supernatant depth of 330 cm (130 in.) (LMHC 1998) is recommended.

An additional recommendation is to modify or prepare sampling and analysis plans to conform to the requirements of Revision 4 of the *Tank Characterization Technical Sampling Basis* (Brown et al. 1998).

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-SY-102.

Issue	Evaluation Performed	TWRS[1] Program Acceptance
Safety screening analysis DQO	Yes	Yes
Organic solvents DQO[2]	No	n/a
Waste compatibility DQO	Yes	Yes
Pretreatment DQO	No	N/R
Privatization DQO	No	N/R

Notes:

N/R = not reviewed

[1]PHMC TWRS Program Office

[2]The organic solvents issue is expected to be closed in fiscal year 1998.

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APPENDIX A

HISTORICAL TANK INFORMATION

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APPENDIX A

HISTORICAL TANK INFORMATION

Appendix A describes tank 241-SY-102 based on historical information. For this report, historical information includes information about the fill history, waste types, surveillance, or modeling data about the tank. This information is necessary for providing a balanced assessment of sampling and analytical results.

This appendix contains the following information:

- **Section A1.0**: Current tank status, including the current waste levels and the tank stabilization and isolation status
- **Section A2.0**: Information about the tank design
- **Section A3.0**: Process knowledge about the tank, the waste transfer history, and the estimated contents of the tank based on modeling data
- **Section A4.0**: Surveillance data for tank 241-SY-102 including surface-level readings, temperatures, and a description of the waste surface based on photographs
- **Section A5.0**: Appendix A References.

A1.0 CURRENT TANK STATUS

As of March 31, 1998, tank 241-SY-102 contained an estimated 2,790 kL (737 kgal) of dilute noncomplexed waste and PFP transuranic waste (Hanlon 1998). The waste volumes were estimated using a manual tape surface level gauge and a manual ENRAF[1] surface level gauge. Table A1-1 shows the volumes of the waste phases found in the tank.

Tank 241-SY-102 went into service in 1977 and remains in active service as a dilute waste receiver tank (Hanlon 1998). The tank is classified as sound and is not on the Watch List (Public Law 101-510).

[1]ENRAF is a trademark of ENRAF Corporation, Houston, Texas.

To avoid disturbing the sludge layer on the bottom of tank 241-SY-102 during waste transfers from the tank, the tank currently has an administrative limit for the *minimum* level of supernatant allowed in the tank (LMHC 1998a). The administrative minimum level is currently set at 330 cm (130 in.), which corresponds to a waste volume of 1,350 kL (358 kgal) in the tank or approximately one-third of the total tank capacity.

Table A1-1. Tank Contents Status Summary.[1]

Waste Type	kL	(kgal)
Total waste[1]	2,790	(737)
Supernatant[2]	2,520	(666)
Sludge[2]	270	(71)
Saltcake[1]	0	0
Drainable interstitial liquid[1]	0	0
Drainable liquid remaining[2]	2,520	(666)
Pumpable liquid remaining[2]	2,520	(666)

Notes:

[1]Hanlon (1998)

[2]Sludge volume estimate is from Appendix D of this TCR and differs from the Hanlon (1998) estimate of 330 kL (88 kgal); the supernatant volume has been adjusted upward from the Hanlon (1998) estimate by 64 kL (17 kgal) to maintain a total waste volume of 2,790 kL (737 kgal).

A2.0 TANK DESIGN AND BACKGROUND

The 241-SY tank farm, which was constructed from 1974 through 1976 in the 200 West Area, contains three double-shell tanks. These tanks have a capacity of 4,390 kL (1,160 kgal) and a diameter of 22.9 m (75.0 ft) and were designed to hold waste with a maximum temperature of 120 °C (250 °F) (Funk et al. 1997).

Funk et al. (1997) and Vitro (1975) provide tank construction details. Tank 241-SY-102 was constructed with a primary carbon steel liner (heat-treated and stress-relieved), a secondary carbon steel liner (not heat-treated), and a reinforced concrete shell. The bottom of the primary liner is 13 mm (0.5 in.) thick, the lower portion of the sides is 19 mm (0.75 in.) thick, the upper portion of the sides is 13 mm (0.5 in.) thick, and the dome liner is 9.5 mm (0.375 in.) thick. The secondary liner is 9.5 mm (0.375 in.) thick. The concrete walls are 460 mm (1.5 ft) thick, and the dome is 380 mm (1.25 ft) thick. The tank has a flat bottom. The bottoms of the primary and secondary liners are separated by an insulating concrete layer.

The concrete foundation beneath the secondary steel liner contains a grid of drain slots. The grid's function is to collect any waste that may leak from the tank and divert it to the leak detection well.

Tank 241-SY-102 has 25 risers ranging in diameter from 100 mm (4 in.) to 1.1 m (42 in.) that penetrate the dome of the primary tank, and 34 risers providing access to the annulus (Tardiff 1997). Three 100-mm (4-in.)-diameter risers (17C, 22A, and 23A) are tentatively available for sampling (Lipnicki 1997). One 100-mm-diameter riser (1A) is not listed as available for sampling but was used to obtain the January 1997 grab samples. Table A2-1 shows numbers, diameters, and descriptions of the risers. (Annulus risers are not included.) Figure A2-1 is a plan view showing the riser locations for tank 241-SY-102. Figure A2-2 is a cross-section view of the tank and shows some of the tank equipment and the approximate waste level.

Table A2-1. Tank 241-SY-102 Risers.[1] (2 sheets)

Riser Number	Diameter		Description and Comments
	cm	(in.)	
1A[2]	10	(4)	Sludge measurement port
1B	10	(4)	Spare
1C	10	(4)	Liquid observation well
2A	10	(4)	ENRAF™ liquid level gauge
3A	30	(12)	Riser for supernatant pump
4A	10	(4)	Thermocouple probe
5A	107	(42)	Spare with shield plug
5B	107	(42)	Spare with shield plug
7A	30	(12)	Specific gravity probe
7B	30	(12)	Tank exhauster port
11A	10	(4)	Spare
11B	10	(4)	Pressure transmitter
12A	107	(42)	Supernatant addition
13A	30	(12)	Observation port
14A	10	(4)	Below grade, drain
15A	10	(4)	Dropleg nozzle
16A	10	(4)	Encasement and valve pit drain
17A	10	(4)	Liquid level indicator: manual tape
17B	10	(4)	Standard Hydrogen Monitoring System sample probe

Table A2-1. Tank 241-SY-102 Risers.[1] (2 sheets)

Riser Number	Diameter		Description and Comments
	cm	(in.)	
17C[3]	10	(4)	Sludge measurement port
22A[3]	10	(4)	Spare
23A[3]	10	(4)	Spare
24A	30	(12)	Riser for supernatant pump
25A	51	(20)	Below grade, welded shut
25B	51	(20)	Below grade, welded shut

Notes:

[1]Tardiff (1997), FDH (1998)

[2]Riser 1A was used to collect the January 1997 grab samples.

[3]These risers are tentatively available for sampling (Lipnicki 1997).

Figure A2-1. Riser Configuration for Tank 241-SY-102.

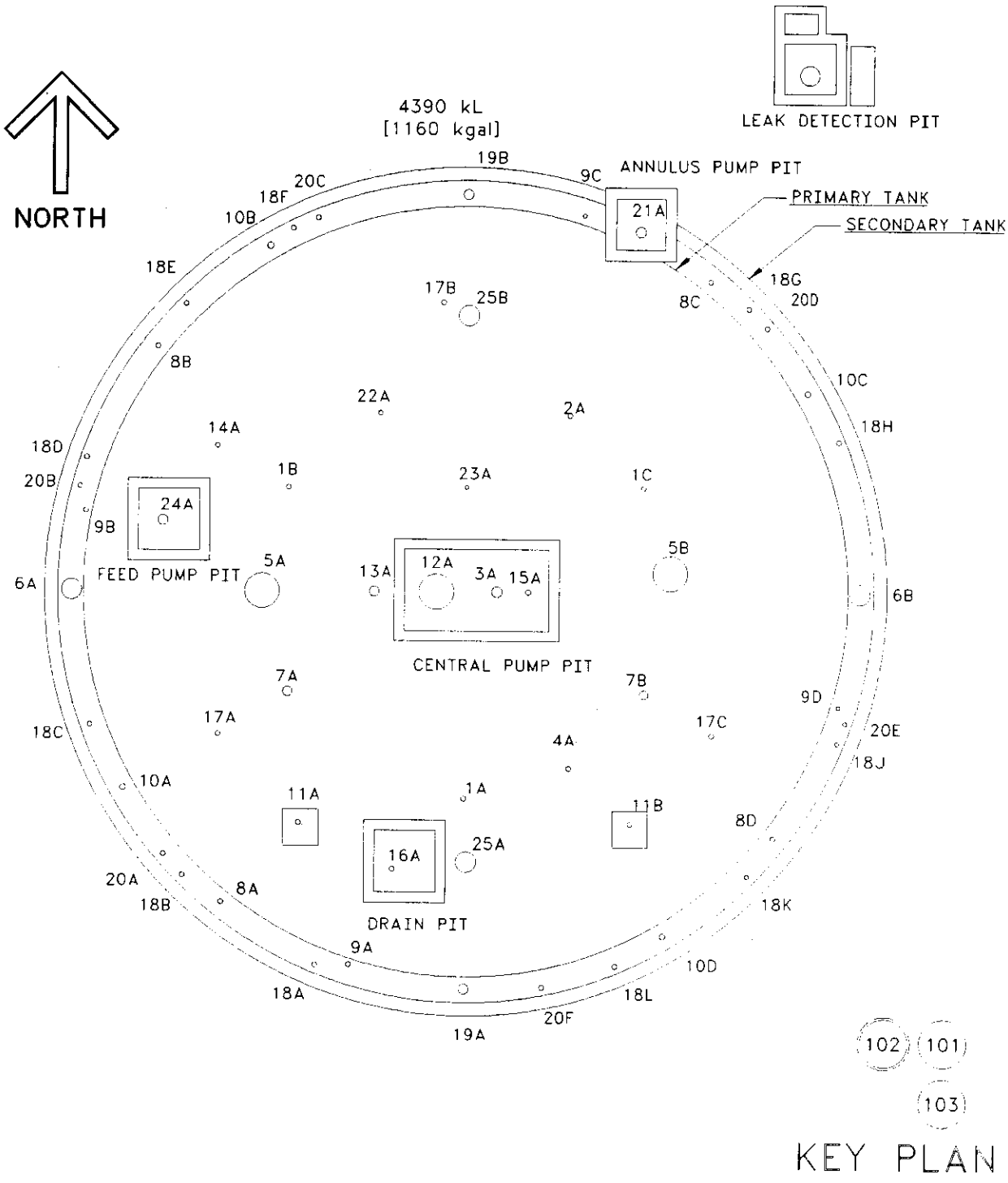
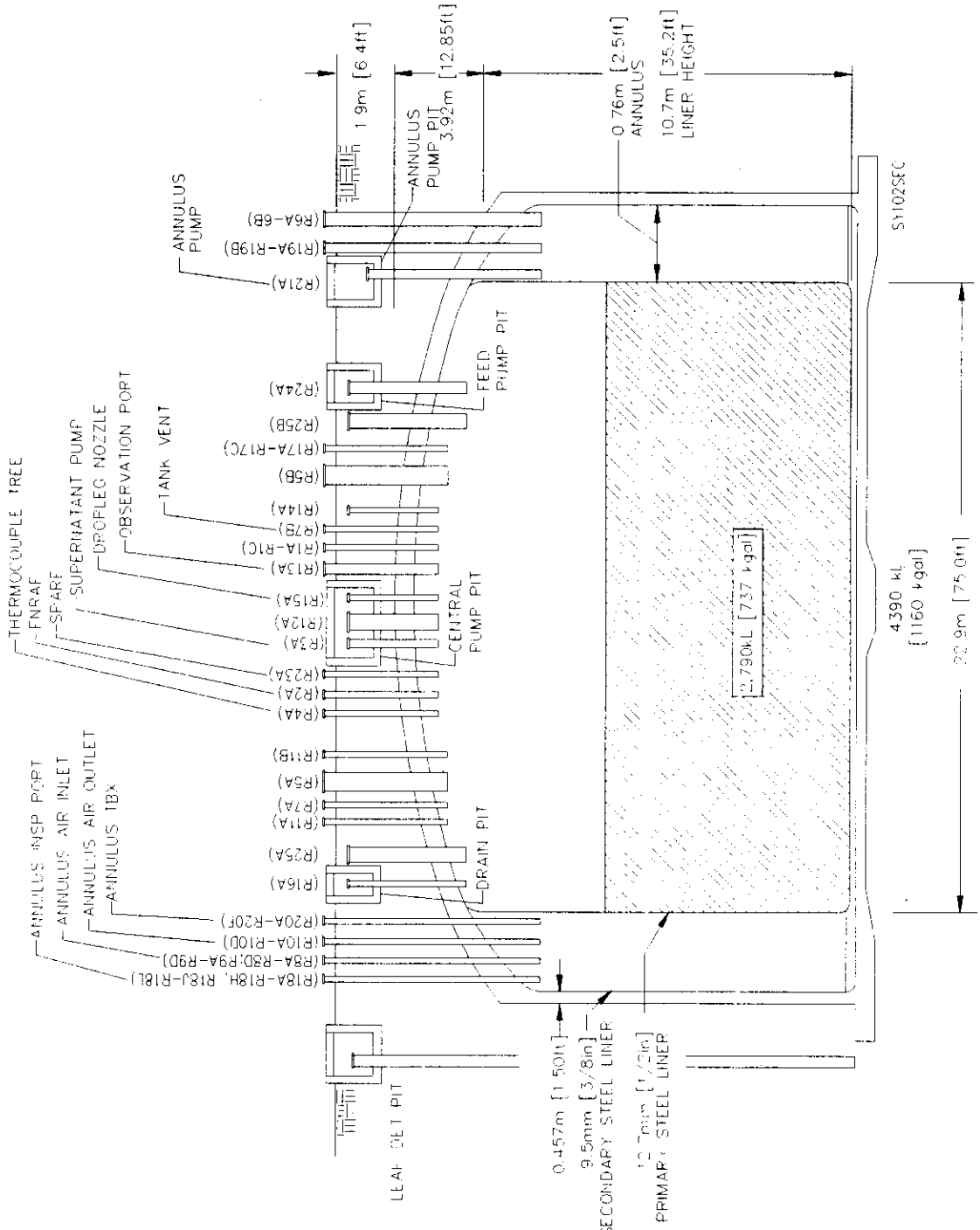


Figure A2-2. Tank 241-SY-102 Cross Section and Schematic.



A3.0 PROCESS KNOWLEDGE

This section provides information about the transfer history of tank 241-SY-102 and describes the process wastes that made up the transfers.

A3.1 WASTE TRANSFER HISTORY

Table A3-1 summarizes the waste transfer history of tank 241-SY-102. Agnew et al. (1997b) was the basis for the waste transfer history from 1977 to 1989, and Koreski (1998) was the basis for the waste transfer history from 1989 to the present.

Tank 241-SY-102 entered service in the second quarter of 1977; from that time until 1981, Agnew et al. (1997b) indicates the tank received mostly supernatant from the 241-S, -SX, -T, -TX, and -U tank farms. During this time, tank 241-SY-102 was also a feed tank for the 242-S Evaporator; output from the evaporator was routed to other 241-SY tanks and to tanks in the 241-A, -S, -SX, and -U tank farms.

Since the last 242-S Evaporator campaign in 1980, tank 241-SY-102 received supernatant from other 200 West Area tanks and processes and was the staging tank for cross-site transfers to 200 East Area double-shell tanks. From the first quarter of 1981 to the second quarter of 1994, the tank received waste from the PFP Laboratory and the 222-S Laboratory. From the first quarter of 1981 to the first quarter of 1990, the tank received decontamination waste from T Plant. From the first quarter of 1981 to the third quarter of 1995, supernatant waste was transferred from tank 241-SY-102 to various 200 East Area double-shell tanks. From the fourth quarter of 1981 to the fourth quarter of 1983, the tank received salt well liquid from various 200 West Area single-shell tanks. From the second quarter of 1982 through the first quarter of 1992, tank 241-SY-102 received dilute noncomplexed waste from the PFP. In 1982, the tank received a single transfer of dilute noncomplexed liquid from the 300 and 400 Area laboratories.

From the second quarter of 1983 through the first quarter of 1988, tank 241-SY-102 received TRU waste from the PFP. These additions of TRU waste are likely the source of the TRU content now found in the sludge layer in tank 241-SY-102. In 1985, the tank received a single transfer of dilute phosphate waste from the 231-Z laboratories and salt well liquid from an unknown tank. In 1993, the tank again began receiving salt well liquid from 200 West Area single-shell tanks. For most of the its history, the tank received flush water from miscellaneous sources. Transfer of waste to tank 241-SY-102 is and will continue to be an ongoing activity. From April 1997 through May 1998, the tank received a total of 300 kL (80 kgal) of salt well liquid and flush water in six transfers that ranged from 19 kL (5 kgal) to 76 kL (20 kgal).

Table A3-1. Tank 241-SY-102 Major Transfers.[1] (2 sheets)

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Waste Volume	
				kL	kgal
241-S, -SX, -T, -TX, -TY, -U tanks[2]		SU	1977 - 1980	75,200	19,900
	241-A, -S, -SX, -SY, -U tanks[3]	242-S Evaporator bottoms	1977 - 1980	81,400	21,500
Unknown		PNF	1977	197	52
Miscellaneous Sources		Flush water	1977 - 1997	24,300	6,410
T Plant		DW	1981 - 1990	11,900	3,150
222-S and PFP labs		Lab waste	1981 - 1994	2,580	681
	241-AN-102, 241-AN-103, 241-AP-104, 241-AW -101, 241-AW-102, 241-AY-102, 241-AZ-101, 241-AZ-102	SU	1981 - 1995	35,500	9,370
241-SX-105, 241-TX, -TY tanks[2]		Salt well liquid	1981 - 1983	5,040	1,330
PFP		DN	1982 - 1992	3,471	917
300 and 400 Areas		Lab waste	1982	49	13
PFP		TRU solids	1983 - 1988	189	50
PFP		DN	1983 - 1985	1,060	281
PFP		ZHigh	1984	734	194

Table A3-1. Tank 241-SY-102 Major Transfers.[1] (2 sheets)

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Waste Volume	
				kL	kgal
231-Z		Lab waste	1985	15	4
241-S, -SX, -T tanks[2]		SU	1993 - 1997	1,350	357

Notes:

DN = dilute noncomplexed liquid waste
DW = decontamination waste
PNF = partial neutralized feed
SU = supernatant
ZHigh = contains TRU and non-TRU waste

[1] Agnew et al. (1997b) and Koreski (1998). This table does not include volume adjustments caused by instrument calibration or evaporation.

[2]Tank 241-SY-102 received waste from a number of tanks within each tank farm.

[3]Agnew et al. (1997b) states these tank farms received waste from tank 241-SY-102. In fact, most of these transfers were not direct; evaporator feed was sent from tank 241-SY-102 to the 242-S Evaporator, and the evaporator bottoms were then sent to tanks in the indicated tank farms.

A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS

Agnew et al. (1997a) estimates the contents of each of the Hanford Site's 177 single-shell and double-shell radioactive waste storage tanks. The historical transfer data used for this estimate are from the following sources:

- The *Waste Status and Transaction Record Summary: WSTRS, Rev. A*, (Agnew et al. 1997b) is a tank-by-tank quarterly summary spreadsheet of waste transactions.

- The *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4* (Agnew et al. 1997a) contains the Hanford defined waste (HDW) list, the supernatant mixing model (SMM), the tank layer model (TLM), and the historical tank content estimate (HTCE).

- The HDW list is comprised of approximately 50 waste types defined by concentration for major analytes/compounds for sludge and supernatant layers.

- The TLM defines the sludge and saltcake layers in each tank using waste composition and waste transfer information.

- The SMM is a subroutine within the HDW model that calculates the volume and composition of certain supernatant blends and concentrates.

Using these records, the TLM defines the sludge layers in each tank. The SMM uses information from the Waste Status and Transaction Record Summary (WSTRS), the TLM, and the HDW list to describe the supernatants and concentrates in each tank. Together, the WSTRS, TLM, SMM, and HDW list determine the historical inventory estimate for each tank. These model predictions are considered estimates that require further evaluation using analytical data.

Because the HDW model only considers waste transfers that occurred through the first quarter of calendar year 1994, the SMM portion of the tank contents tabulated in Agnew et al. (1997a) is not current for tank 241-SY-102. Therefore, only the TLM portion of the HDW model is presented.

Agnew et al. (1997a) identifies the solids in tank 241-SY-102 as including 155 kL (41 kgal) of S2 saltcake (S2SltCk), 95 kL (25 kgal) of Z Plant wastes (Z) and 19 kL (5 kgal) of decontamination waste (DW) from T Plant. (In the following discussion, the component weight percents may not total exactly 100 percent either because the minor [less than one percent] components are not listed or because of rounding errors.) According to the HDW, the S2SltCk solids have a weight-percent composition of 26 percent sodium, 21 percent water, 17 percent nitrate, 15 percent hydroxide (total), 10 percent nitrite, 4 percent aluminum, 3 percent sulfate, 2 percent carbonate, 2 percent phosphate, and 1 percent TOC. The S2SltCk radionuclides consist primarily of ^{90}Sr and ^{137}Cs. The HDW model Z waste consists primarily of 38 percent hydroxide (total), 29 percent water, 17 percent aluminum, 5 percent nitrate, 5 percent iron, 3 percent sodium, 2 percent carbonate, and 1 percent calcium. Radionuclides contributed by the Z waste are primarily plutonium and americium. The HDW model DW is composed of 53 percent water, 17 percent hydroxide (total), 15 percent iron, 4 percent carbonate, 3 percent chromium, 3 percent sulfate, 2 percent sodium, 2 percent nickel, and 2 percent calcium. The HDW model lists no radionuclides for DW. Table A3-2 shows the historical concentration estimates of the expected constituents in the sludge.

Table A3-2. Historical Tank Inventory Estimate[1, 2] (4 sheets)

TLM Solids Composite Inventory Estimate					
Physical Properties				**-95 CI**	**+95 CI**
Total waste	4.94E+05 (kg)	(70.9 kgal)	n/a	n/a	n/a
Heat load	0.514 (kW)	(1.76E+03 Btu/hr)	n/a	0.285 (kW)	0.729 (kW)
Bulk density (g/cm^3)	1.84	n/a	n/a	1.62	2.01
Water wt%	25.5	n/a	n/a	17.8	38.0
TOC wt% C (wet)	0.820	n/a	n/a	0.416	1.17
Constituents	***M***	**µg/g**	**kg**	**-95 CI (*M*)**	**+95 CI (*M*)**
Na^+	13.8	1.72E+05	85,000	8.42	18.1
Al^{3+}	5.53	81,100	40,100	4.98	6.01
Fe^{3+}	0.873	26,500	13,100	0.830	0.887
Cr^{3+}	0.136	3,860	1,900	0.112	0.149
Bi^{3+}	0.00336	382	189	0.00284	0.00388
La^{3+}	9.88E-06	0.746	0.368	6.70E-06	1.30E-05
Hg^{2+}	1.42E-05	1.55	0.765	1.28E-05	1.55E-05
Zr	3.76E-4	18.6	9.2	2.50E-04	4.99E-04
Pb^{2+}	0.00129	145	71.8	7.05E-04	0.00188
Ni^{2+}	0.0643	2,050	1,010	0.0303	0.0670
Sr^{2+}	0.00	0.00	0.00	0.00	0.00
Mn^{4+}	0.00139	41.5	20.5	9.83E-04	0.00180
Ca^{2+}	0.220	4,790	2,370	0.0762	0.273
K^+	0.0784	1,670	823	0.0450	0.116
OH^-	24.7	2.29E+05	1.13E+05	21.3	27.9
NO_3^-	3.60	1.21E+05	59,800	2.39	4.05
NO_2^-	2.43	60,800	30,000	1.26	3.58
CO_3^{2-}	0.656	21,400	10,600	0.470	0.807
PO_4^{3-}	0.199	10,200	5,060	0.137	0.218
SO_4^{2-}	0.383	20,000	9,870	0.174	0.609
Si	0.0433	661	326	0.0238	0.0608
F^-	0.0708	730	361	0.0404	0.0884
Cl^-	0.0956	1,840	909	0.0582	0.127

Table A3-2. Historical Tank Inven[illegible] Estimate[1, 2] (4 sheets)

TLM Solids Composite Inv[illegible]ry Estimate					
Constituents (Cont'd)	***M***	**μg/g**	**kg**	**-95 CI (*M*)**	**+95 CI (*M*)**
$Citrate^{3-}$	0.0322	3,300	1,630	0.0246	0.0389
$EDTA^{4-}$	0.0194	3,040	1,500	0.00493	0.0345
$HEDTA^{3-}$	0.0364	5,430	2,680	0.00805	0.0659
$Glycolate^{-}$	0.105	4,270	2,110	0.0367	0.174
$Acetate^{-}$	0.00782	251	124	0.00583	0.0101
$Oxalate^{2-}$	1.29E-05	0.619	0.306	1.15E-05	1.44E-05
DBP	0.0233	2,670	1,320	0.0165	0.0298
Butanol	0.0233	940	464	0.0165	0.0298
NH_3	0.0486	449	222	0.0231	0.0815
$Fe(CN)_6^{4-}$	0.00	0.00	0.00	0.00	0.00
Radiological Constituents	**Ci/L**	**μCi/g**	**Ci**	**-95 CI (Ci/L)**	**+95 CI (Ci/L)**
^{3}H	2.76E-04	0.1.50	74.0	0.00	2.84E-04
^{14}C	3.57E-05	0.0194	9.59	0.00	3.61E-05
^{59}Ni	6.11E-07	3.32E-04	0.164	0.00	6.65E-07
^{63}Ni	6.01E-05	0.0327	16.1	0.00	6.55E-05
^{60}Co	2.55E-05	0.0139	6.84	0.00	2.57E-05
^{79}Se	2.27E-06	0.00123	0.609	0.00	3.27E-06
^{90}Sr	0.0447	24.3	12,000	0.0340	0.0512
^{90}Y	0.0448	24.3	12,000	0.00	0.0498
^{93}Zr	1.11E-05	0.00605	2.99	0.00	1.60E-05
^{93m}Nb	8.13E-06	0.00442	2.18	0.00	1.16E-05
^{99}Tc	3.17E-04	0.172	85.1	1.46E-04	4.95E-04
^{106}Ru	4.29E-09	2.33E-06	0.00115	0.00	6.39E-09
^{113m}Cd	5.77E-05	0.0313	15.5	0.00	8.21E-05
^{125}Sb	1.12E-04	0.0609	30.1	0.00	1.13E-04
^{126}Sn	3.43E-06	0.00187	0.921	0.00	4.94E-06
^{129}I	6.12E-07	3.33E-04	0.164	2.82E-07	9.56E-07
^{134}Cs	3.27E-06	0.00178	0.879	0.00	3.31E-06
^{137}Cs	0.345	1.87E+02	92,500	0.178	0.506

Table A3-2. Historical Tank Inventory Estimate[1, 2] (4 sheets)

TLM Solids Composite Inventory Estimate					
Radiological Constituents (Cont'd)	**Ci/L**	**μCi/g**	**Ci**	**-95 CI (Ci/L)**	**+95 CI (Ci/L)**
^{137m}Ba	0.326	1.77E+02	87,500	0.00	0.329
^{151}Sm	0.00800	4.35	2,150	0.00	0.0115
^{152}Eu	2.76E-06	0.00150	0.741	0.00	2.78E-06
^{154}Eu	4.02E-04	0.218	108	0.00	5.39E-04
^{155}Eu	1.64E-04	0.0891	44.0	0.00	1.65E-04
^{226}Ra	1.01E-10	5.51E-08	2.72E-05	0.00	1.60E-10
^{228}Ra	7.21E-08	3.92E-05	0.0194	0.00	7.33E-08
^{227}Ac	6.23E-10	3.39E-07	1.67E-04	0.00	9.68E-10
^{231}Pa	2.79E-09	1.52E-06	7.49E-04	0.00	3.93E-09
^{229}Th	1.75E-09	9.52E-07	4.70E-04	0.00	1.78E-09
^{232}Th	7.98E-09	4.33E-06	0.00214	0.00	1.14E-08
^{232}U	1.74E-07	9.45E-05	0.0467	1.09E-07	2.58E-07
^{233}U	6.68E-07	3.63E-04	0.179	4.17E-07	9.90E-07
^{234}U	3.74E-07	2.03E-04	0.100	3.29E-07	4.10E-07
^{235}U	1.57E-08	8.51E-06	0.00420	1.39E-08	1.71E-08
^{236}U	8.99E-09	4.89E-06	0.00241	7.80E-09	9.85E-09
^{238}U[3]	4.61E-07	2.50E-04	0.124	4.22E-07	4.94E-07
^{237}Np	1.16E-06	6.29E-04	0.311	5.69E-07	1.77E-06
^{238}Pu	5.62E-07	3.06E-04	0.151	2.78E-07	8.51E-07
^{239}Pu	0.00984	5.34	2,640	0.00965	0.00993
^{240}Pu	0.00246	1.33	659	0.00241	0.00248
^{241}Pu	3.78E-05	0.0205	10.1	1.93E-05	5.66E-05
^{242}Pu	2.04E-10	1.11E-07	5.48E-05	9.96E-11	3.12E-10
^{241}Am	0.0104	5.63	2,780	0.00971	0.0107
^{243}Am	2.50E-09	1.36E-06	6.70E-04	7.24E-10	4.41E-09
^{242}Cm	2.28E-10	1.24E-07	6.11E-05	0.00	2.33E-10
^{243}Cm	4.65E-12	2.53E-09	1.25E-06	0.00	4.76E-12
^{244}Cm	1.35E-10	7.36E-08	3.63E-05	0.00	1.38E-10

ble A3-2. Historical T: nventory Estimate[1,2] (4 sheets)

TLM Solids Com ate Inventory Estimate					
Totals		**μg/g**	**kg**	**-95 CI**	**+95 CI**
Pu	0.172 (g/L)	n/a	46.1	0.169 (g/L)	0.173 (g/L)
U	0.00446 (*M*)	577	285	0.00395 (*M*)	0.00487 (*M*)

Notes:

CI = confidence interval
wt% = weight percent

[1]Agnew et al. (1997a)
[2]These model estimates have not been validated and should be used with caution.
[3]The model values for ^{238}U are not correct; see Appendix D.

A4.0 SURVEILLANCE DATA

Tank 241-SY-102 surveillance consists of surface-level measurements (liquid and solid), temperature monitoring inside the tank (waste and headspace), a radiation monitor and conductivity probe in the tank annulus, and a standard hydrogen monitoring system (SHMS) (FDH 1998, Funk et al. 1997, Jensen 1997, and Welty 1988). Surveillance data from these various systems provide the basis for determining tank integrity. The principal means of detecting potential leaks from the primary (inner) tank are the conductivity probe and radiation monitor located in the tank annulus. Additional radiation monitors, specific gravity probes, and thermocouples in the tank leak-detection pit indicate potential leaks from the secondary (outer) tank. The SY Tank Farm is not equipped with dry well monitors. Solid surface-level measurements indicate physical changes in and consistencies of the solid layers in the tank. The SHMS system provides the means for monitoring the tank headspace for hydrogen gas concentration.

A4.1 SURFACE-LEVEL READINGS

Welty (1988) lists requirements and criteria for liquid surface level monitoring in tank 241-SY-102. Liquid surface-level readings are a secondary method for determining possible primary tank leakage; an increase in radiation levels in air samples drawn from the tank annulus is the primary leak detection method. Liquid surface levels are acquired on a daily basis by means of a manual ENRAF™ gauge in riser 2A and a manual tape in riser 17A (FDH 1998). The liquid-level leak-detection criteria for tank 241-SY-102 are a decrease of 13 cm (5 in.) and an increase of 7.6 cm (3 in.). From April 1, 1997, to March 31, 1998, the manual tape readings increased from 586.1 cm (230.75 in.) to 683.3 cm (269.0 in.), and the manual ENRAF™ readings increased from 584.5 cm (230.1 in.) to 681.4 cm (268.25 in.)

(LMHC 1998b). The level increased because of intentional additions of supernatant to the tank. Figure A4-1 is a level history graph of the volume measurements; the graph illustrates the active usage of the tank.

A4.2 INTERNAL TANK TEMPERATURES

Tank 241-SY-102 has a single thermocouple tree with 18 type J thermocouples to monitor the waste temperature through riser 4A (FDH 1998 and Tran 1993). Thermocouple 1 is 22.6 cm (0.74 ft) from the tank bottom. Thermocouples 2 though 16 are spaced at 61-cm (2-ft) intervals above thermocouple 1. Thermocouples 17 and 18 are at 1.22-m (4-ft) intervals. All thermocouples are functional.

Tank temperature data are available for the time period from January 7, 1991, to March 31, 1998. For the period April 1, 1997, through March 31, 1998, the average tank temperature was 17.1 °C (62.7 °F), the minimum was 9.4 °C (49.0 °F), and the maximum was 22.8 °C (73.0 °F) (LMHC 1998b). For plots of the thermocouple readings, see Appendix D of Funk et al. (1997). Figure A4-2 is a graph of the weekly high temperature.

A4.3 TANK ANNULUS LEAK DETECTION

The principal means of detecting potential leaks from the primary (inner) tank are a conductivity probe and radiation monitor located in the tank annulus (Jensen 1997 and Welty 1988). Data from the conductivity probe and radiation monitor are manually recorded on data sheets once per shift. Alarms from the leak detection monitors are automatically transmitted to the Computer Automated Surveillance System. Surveillance equipment alarms and any malfunctions are reported in weekly West Area tank farm equipment/anomaly reports. For the period November 19, 1987 through March 31, 1998, the weekly equipment/anomaly reports recorded no anomalies or alarms for the tank 241-SY-102 annulus conductivity probe or radiation monitor.

A4.4 STANDARD HYDROGEN MONITORING SYSTEM

Schneider (1997), Schneider and Philipp (1997), and Wilkins et al. (1997) describe the SHMS type E that monitors the vapor phase in the tank 241-SY-102 headspace. The SHMS measures parts-per-million levels of hydrogen, methane, nitrous oxide, and ammonia. The tank 241-SY-102 SHMS went into service on February 5, 1998. Section B2.3.1 presents the surveillance results from the SHMS.

A4.5 TANK 241-SY-102 PHOTOGRAPHS

The most recent interior tank photographs showing the tank waste were taken on April 29, 1981 (Hanlon 1998). The April 29 photographs were used to create a montage of the tank interior. The montage has labels identifying some of the monitoring equipment, piping, and risers in the tank. However, the only tank waste visible in these photographs is the supernatant, and because of the transient nature of the supernatant waste and supernatant volumes in the tank, the photographs may not represent current tank contents. Furthermore, because equipment in the tank has changed since the photographs were taken, the montage may no longer represent the current equipment conditions in the tank. The montage and photographic information are shown in Appendix G of Funk et al. (1997).

Figure A4-1. Tank 241-SY-102 Level History.

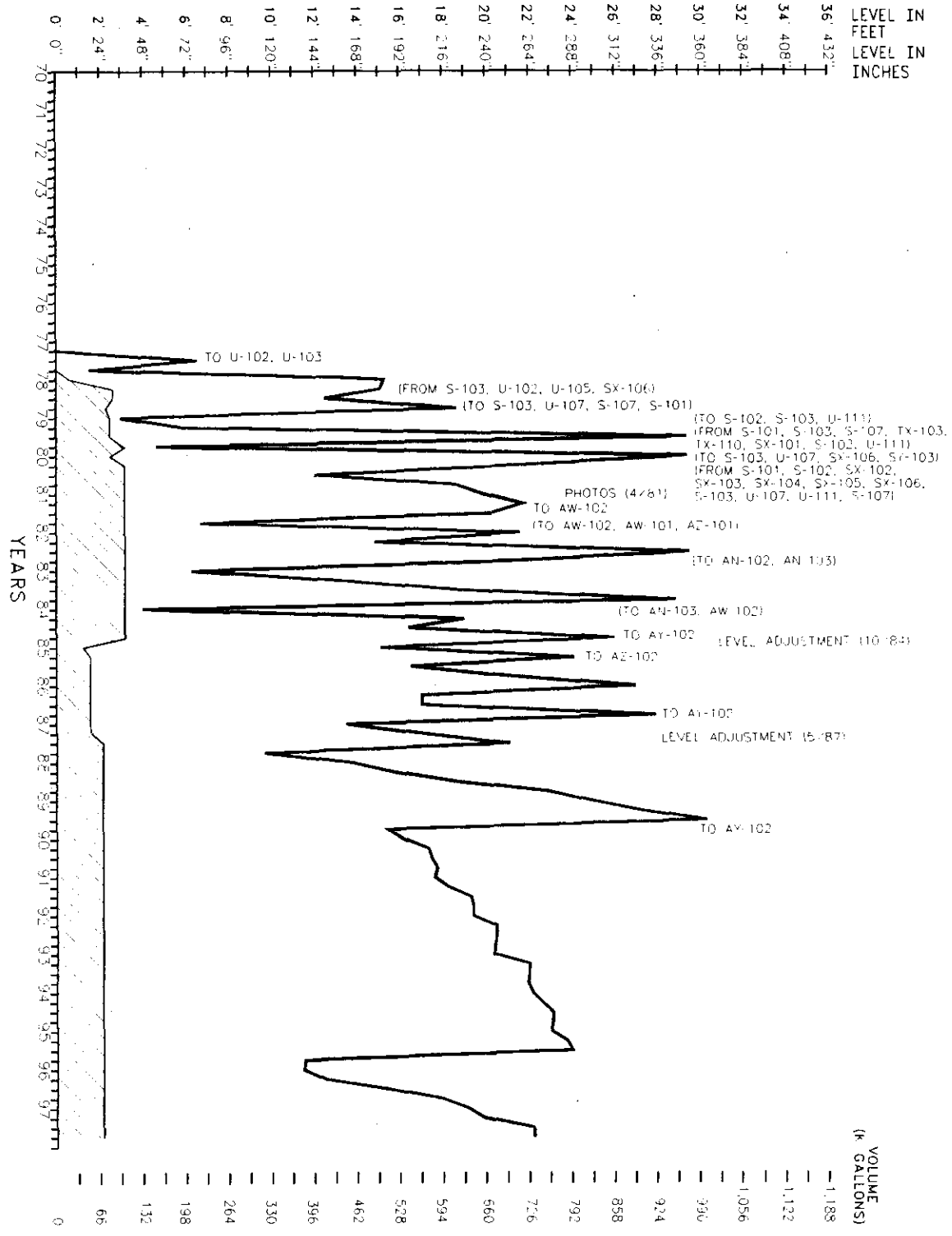
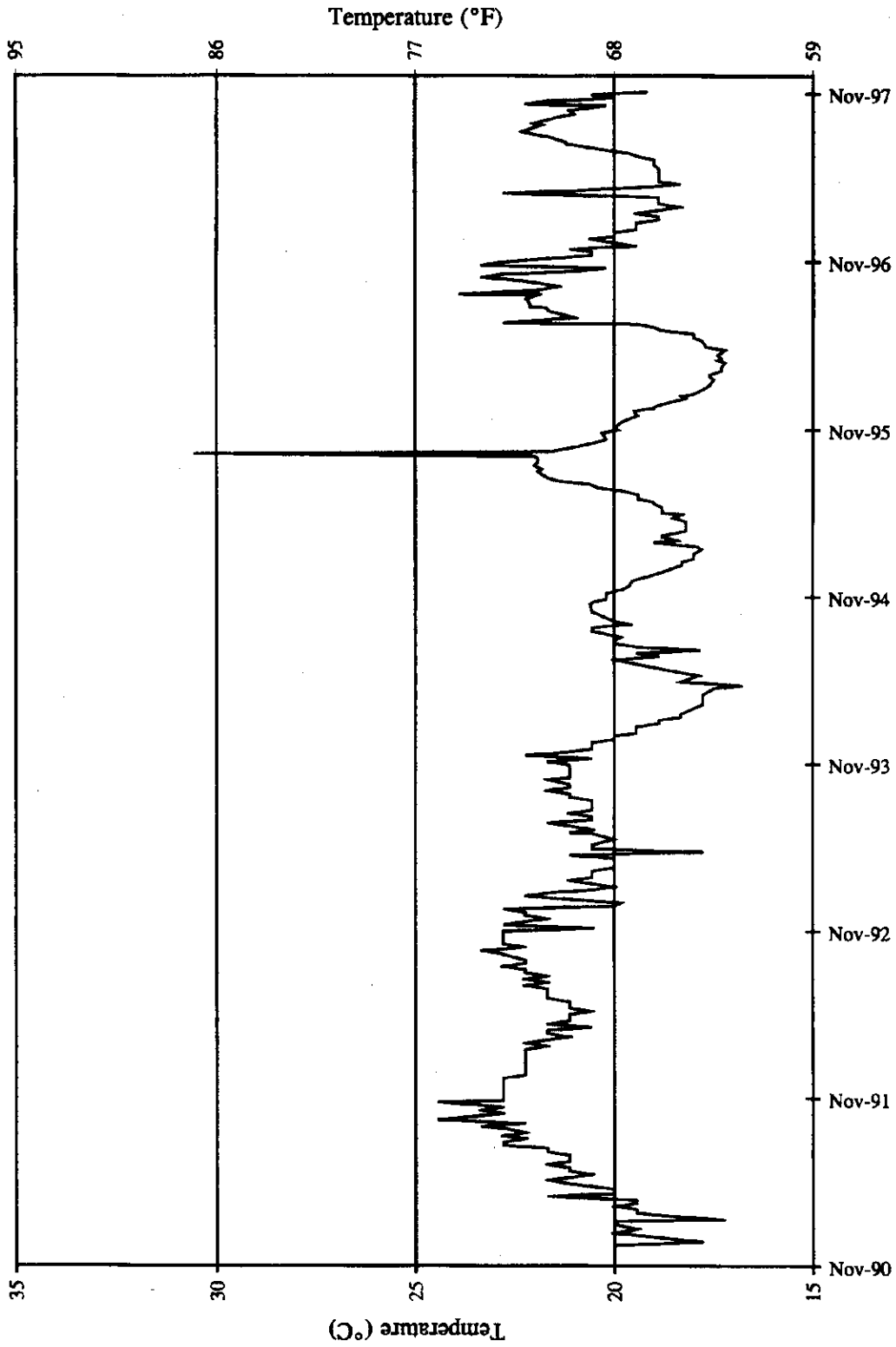


Figure A4-2. Tank 241-SY-102 High Temperature Plot.



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APPENDIX B

SAMPLING OF TANK 241-SY-102

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APPENDIX B

SAMPLING OF TANK 241-SY-102

Appendix B provides sampling and analysis information for each known sampling event for tank 241-SY-102 and assesses sample results. It includes the following:

- **Section B1.0**: Tank Sampling Overview
- **Section B2.0**: Sampling Events
- **Section B3.0**: Assessment of Characterization Results
- **Section B4.0**: Appendix B References.

Future sampling information for tank 241-SY-102 will be appended to future revisions of this TCR.

B1.0 TANK SAMPLING OVERVIEW

This section describes the January 1997 grab and the July/August 1997 push mode core sampling and analysis events for tank 241-SY-102. The most recent liquid grab sampling of the supernatant in tank 241-SY-102 occurred in March 1998; the results from the March 1998 sampling were not available in time to be included in this report. For further discussions of the tank sampling and analysis procedures, refer to the *Tank Characterization Reference Guide* (DeLorenzo et al. 1994).

The *Compatibility Grab Sampling and Analysis Plan for Fiscal Year 1997* (Sasaki 1997a) governed the acquisition and analysis of the January 1997 grab samples. These grab samples were taken to satisfy the requirements of the *Data Quality Objectives for the Tank Farms Waste Compatibility Program* (Fowler 1995). Since the January 1997 grab sampling event, Fowler (1995) has been superseded by Revision 2 of the compatibility DQO (Mulkey and Miller 1997). At the time of the grab sampling, the tank contained approximately 270 kL (71 kgal) of solids and 2,040 kL (540 kgal) of supernatant. After the January 1997 grab sampling through March 31, 1998, approximately 477 kL (126 kgal) of liquid has been added to tank 241-SY-102 (Hanlon 1998). The additional liquid was a combination of salt well liquid pumped from West Area single-shell tanks and process water.

The *Tank 241-SY-102 Push Mode Core Sampling and Analysis Plan* (Sasaki 1997b) prescribed the requirements for the July/August 1997 push mode core sampling of tank 241-SY-102. The push mode core sampling was performed to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995) and the *Implementation Change Concerning Organic DQO, Rev 2* (Meacham 1996). The ammonia analyses were performed to meet the requirements of the *Scope Increase for All Liquid Samples Taken from Single-Shell or Receiver Tanks* (Hall 1997). Sasaki (1997b) required that 150 g of composite be archived to meet the requirements of the Pretreatment Program and the Privatization Program (Kirkbride 1997). At the time of the July/August 1997 sampling, the tank contained approximately 270 kL (71 kgal) of solids and 2,320 kL (612 kgal) of supernatant. After the July/August 1997 core sampling through March 31, 1998, approximately 204 kL (54 kgal) of liquid has been added to tank 241-SY-102 (Hanlon 1998). The additional liquid was a combination of salt well liquid pumped from West Area single-shell tanks and process water.

A liquid grab sample was also taken from tank 241-SY-102 in October 1995 (Esch 1995 and Schreiber 1995). Between the time of the October 1995 and January 1997 grab samplings, approximately 874 kL (231 kgal) of liquid consisting of salt well-pumped liquid from West Area single-shell tanks and process water was added to the tank (LMHC 1998). Therefore, the results of the October 1995 grab sampling are tabulated in Section B2.0, Tables B2-141 through B2-161, but are not discussed in this TCR.

Two historical core samplings of tank 241-SY-102 have occurred, one in 1988 (Scheele and Peterson 1990 and Weiss 1990) and one in 1990 (Tingey and Sasaki 1995). Numerous grab samples have also been acquired during the operation of tank 241-SY-102; most of these samples were for process control and waste compatibility purposes and are not discussed further in this report.

B2.0 SAMPLING EVENTS

This section describes recent sampling events. The analytical results used to characterize current tank contents were from the January 1997 grab samples (see Tables B2-17 through B2-73) and the July/August 1997 core samples (see Tables B2-74 through B2-140). Historical sample results are presented in Section 2.4. Table B2-1 summarizes the sampling and analytical requirements from applicable DQOs for the two sampling events.

Table B2-1. Integrated Data Quality Objective Requirements for Tank 241-SY-102.[1]

Sampling Event	Applicable DQOs	Sampling Requirements	Analytical Requirements
Grab sampling	Compatibility - Energetics/organics - Corrosion - Criticality - Flammable gas (Mulkey and Miller 1997)	Grab samples	Energetics, moisture, anions, cations, radionuclides, specific gravity, pH, separable organics, TOC, TIC, percent solids
Push mode core sampling	Safety Screening - Energetics - Moisture content - Total alpha - Flammable gas (Dukelow et al. 1995)	Core samples from a minimum of two risers separated radially to the maximum extent possible.	Flammability, energetics, moisture, total alpha activity, SpG and density, ICP (Al, Cr, Fe, Na, Ni, Si), $^{239/240}$Pu
	Pretreatment (Kupfer et al. 1995)	not specified	Anions, ICP (Cr, K, Zr), ^{90}Sr, ^{137}Cs, TRU, organic complexants[2]
	Privatization (Jones and Wiemers 1996)	Solids composite	bulk density, volume-percent settled solids, ICP (Al, Cr, Fe, Na, Ni, Si), total alpha activity, total beta activity, GEA, TRU, ^{90}Sr

Notes:

GEA = gamma energy analysis
SpG = specific gravity

[1]See Section 2.0 of this TCR.

[2]Kupfer et al. (1995) makes no claim that this is an exhaustive list of all analytes significant to the pretreatment program.

B2.1 JANUARY 1997 GRAB SAMPLING EVENT

The *Compatibility Grab Sampling and Analysis Plan for Fiscal Year 1997* (Sasaki 1997a) governed the January 1997 grab sampling of the supernatant in tank 241-SY-102. The grab sample work package (LMHC 1997a) describes the sampling event, and Nuzum (1997) presents the analytical results from the grab samples. Sasaki (1997a) prescribed that the samples be obtained at different depths to sample near the top, middle, and bottom of the supernatant. At the time of the grab sampling, the tank contained approximately 270 kL (71 kgal) of solids and 2,040 kL (540 kgal) of supernatant. Three grab samples were obtained through riser 1A on January 14, 1997, using the "bottle-on-a-string" method (ASTM 1973) and were approximately 125 mL each in volume. The samples were delivered to the 222-S Laboratory on the same day and were analyzed from January 22, 1997, through April 1, 1997. Before the sampling, combustible gas meter readings were performed in the field to measure flammability in the tank headspace.

The January 1997 grab samples were obtained to meet the requirements of Revision 1 of the *Data Quality Objectives for the Tank Farms Waste Compatibility Program* (Fowler 1995). Since the January 1997 grab sampling event, Revision 2 of the compatibility DQO has been issued (Mulkey and Miller 1997). With regard to the grab sampling protocol, the major difference between the two revisions is that Revision 2 recommends the collection of a duplicate grab sample to assess the statistical error associated with sampling. For the January 1997 grab samples, no field blanks or sample duplicates were required or collected.

Tables B2-2 and B2-3 present sampling information and sample descriptions for the three grab samples. Section B3.1.1 provides an assessment of the sampling event and any effects the sampling event may have on interpretation of the data.

Table B2-2. Tank 241-SY-102, January 14, 1997, Grab Sample Subsampling Scheme and Sample Description.[1]

Riser	Sample ID	Weight (g)	Sample Portion	Sample Characteristics
1A	2SY-96-1	n/r	Whole	Clear yellow, no separable organic layer, <5% solids
1A	2SY-96-2	n/r	Whole	Clear, dark yellow, no separable organic layer, <5% solids
1A	2SY-96-3	n/r	Whole	Opaque, dark-brown sludge, no separable organic layer, 99% solids

Notes:
n/r = not reported
[1]Nuzum (1997)

Table B2-3. Sampling Information for Tank 241-SY-102, January 14, 1997, Grab Samples.[1, 2]

Field Sample Number	Lab Sample Number	Sample Depth[3]		Sample Elevation[4]		Contact Dose Rate (mRad/hr)
		m	ft	m	ft	
2SY-96-1	S97T000011	11.30	37.08	5.48	17.97	70
2SY-96-2	S97T000012	14.35	47.08	2.43	7.97	220
2SY-96-3	S97T000013	16.34	53.63	0.43	1.42	450

Notes:

[1]LMHC (1997a) and Nuzum (1997)

[2]All samples were obtained through Riser 1A and were a nominal 125 mL volume.

[3]Sample depth is defined as the distance from the top of the riser flange to the sample bottle mouth.

[4]Sample elevation is defined as the distance from the tank bottom to the mouth of the sample bottle. The elevation of the tank bottom is 188.13 m (617.24 ft) above sea level (Vitro 1975). The elevation of riser 1A is 204.91 m (672.287 ft) above sea level (Lipnicki 1997). The surface level of supernatant waste on the sampling date was at elevation 5.64 m (18.5 ft).

B2.1.1 Sample Handling (January 1997)

The 222-S laboratory logged in the grab samples the same day the samples were acquired. After receipt, the samples were visually examined and over-the-top dose rates were obtained (Nuzum 1997). Samples 2SY-96-1 and 2SY-96-2 were described as clear, yellow-to-dark-yellow, liquid samples. Aliquots of these two samples were taken and prepared as needed for each required analysis. Sample 2SY-96-3 was described as containing opaque, dark-brown solids. According to Nuzum (1997), sample 2SY-96-3 had insufficient supernatant to perform all analyses; therefore, no waste compatibility sample results were reported for this sample. (Some analytical results were reported for sample 2SY-96-3, but these were reported as "information only.") None of the samples had a layer identifiable as a separable organic phase.

B2.1.2 Sample Analysis (January 1997)

The analyses performed on the grab samples were those required by the waste compatibility DQO (Fowler 1995). The DQO required the following analyses: visual determination of separable organic layers, energetics by DSC, percent water by thermogravimetric analysis (TGA), specific gravity/bulk density, free hydroxide, pH, anions by ion chromatography (IC), metals (aluminum, iron, and sodium) by ICP, TIC/TOC, ammonia, ^{90}Sr, ^{137}Cs by GEA,

$^{239/240}Pu$, and ^{241}Am. All reported analyses were performed according to approved laboratory procedures. The samples were analyzed in the laboratory from January 22, 1997 through April 1, 1997. Table B2-4 outlines the analytes and analytical procedures used. Table B2-5 is a summary of the sample portions, sample numbers, and analyses performed on each sample.

Table B2-4. Tank 241-SY-102 Analytical Methods and Procedures for January 1997 Grab Samples.[1]

Analyte	Method	Procedure
Energetics	Differential scanning calorimeter	LA-514-113 LA-514-114
Percent water	Thermogravimetric analysis	LA-560-112
Flammable gas	Combustible gas analyzer	WHC-IP-0030 IH 1.4 and IH 2.1[2]
Total organic carbon	Furnace oxidation/coulometer	LA-344-105
Total inorganic carbon	Hot persulfate oxidation/coulometer	LA-342-100
ICP/AES analytes	Inductively coupled plasma/atomic emission spectrometer	LA-505-161
IC analytes (anions)	Ion chromatograph	LA-533-105
GEA radionuclides (^{60}Co, ^{137}Cs)	Gamma energy analyzer	LA-548-121
Strontium-90	Strontium carbonate precipitation / beta proportional counter	LA-220-101
Plutonium-239/240	CMPO separation/alpha counter	LA-943-128
Americium-241	CMPO separation/alpha counter	LA-953-103
Free hydroxide	Potentiometric titration	LA-211-102
pH measurement	pH electrode	LA-212-106
Specific gravity	Gravimetric	LA-510-112
Ammonia	Ammonia-selective electrode	LA-631-001
Sample appearance	Visual inspection	LA-519-151

Notes:

CMPO = octyl(phenyl)-N,N-di-iso-butyl-carbamoyl methylphosphine oxide
IC = ion chromatography
AES = atomic emission spectroscopy

[1]Nuzum (1997)
[2]WHC (1992a) and WHC (1992b)

Table B2-5. Tank 241-SY-102 January 1997 Grab Sample Analysis Summary.[1]

Riser	Field Sample Number	Laboratory Sample Number	Analyses
1A	2SY-96-1	S97T000011	Appearance
		S97T000024	DSC, TGA, TOC, TIC, ICP, IC, pH, hydroxide, SpG, ammonia
		S97T000025	GEA, ^{90}Sr, $^{239/240}$Pu, ^{241}Am
	2SY-96-2	S97T000012	Appearance
		S97T000026	DSC, TGA, TOC, TIC, ICP, IC, pH, hydroxide, SpG, ammonia
		S97T000028	GEA, ^{90}Sr, $^{239/240}$Pu, ^{241}Am
	2SY-96-3 [2]	S97T000013	Appearance
		S97T000027	DSC, TGA, TOC, TIC, IC, pH, hydroxide
		S97T000029	GEA, ^{90}Sr

Notes:

[1]Nuzum (1997)

[2]Some analyses were performed on the liquid portion of this sample. Nuzum (1997) indicates the results for this sample are suspect because the separation between the solid and supernatant phases was inadequate. The waste compatibility results for this sample are reported for information only.

B2.1.3 Analytical Results (January 1997)

This section summarizes the sampling and analytical results associated with the January 1997 grab sampling and analysis of tank 241-SY-102. Table B2-6 indicates which tables contain the analytical results associated with this tank. Nuzum (1997) is the source of the analytical results.

Table B2-6. Analytical Tables for the Tank 241-SY-102 January 1997 Grab Sample Results.

Analysis	Table Number
Inductively coupled plasma/atomic emission spectroscopy	B2-17 through B2-53
Ion chromatography	B2-54 through B2-61
Percent water by thermogravimetric analysis	B2-62
pH measurement	B2-63
Specific gravity	B2-64
Gamma energy analysis (^{60}Co, ^{137}Cs)	B2-65 and B2-66
Strontium-90	B2-67
Plutonium-239/240	B2-68
Americium-241	B2-69
Total organic carbon by furnace oxidation	B2-70
Total inorganic carbon	B2-71
Ammonia	B2-72
Hydroxide	B2-73

The four quality control (QC) parameters assessed in conjunction with the tank 241-SY-102 January 1997 grab samples were standard recoveries, spike recoveries, duplicate analyses, and laboratory blanks. The QC criteria were specified in the SAP (Sasaki 1997a). For duplicate analyses, the allowed relative percent difference (RPD) was ≤20 percent. For the ICP, ^{90}Sr, and $^{239/240}$Pu analyses, recommended percent recoveries for spikes were 75 to 125 percent; percent recovery limit for spikes were not specified for the other analyses. Criteria for acceptable laboratory blanks were less than the estimated quantitation limit for ICP, and less than the minimum detectable activity for ^{90}Sr and $^{239/240}$Pu. Allowable percent recoveries for laboratory control standards were as follows: 80 to 120 percent for DSC, TGA, ICP, IC, and TOC; 75 to 125 percent for ^{90}Sr; 70 to 130 percent for $^{239/240}$Pu; and not listed for the remaining analyses.

Sample and duplicate pairs, in which any QC parameter was outside these limits, are footnoted in the sample mean column of the following data summary tables with an a, b, c, d, e, f, g, h, I, or j as follows.

- "a" indicates the standard recovery was below the QC limit.
- "b" indicates the standard recovery was above the QC limit.

- "c" indicates the spike recovery was below the QC limit.
- "d" indicates the spike recovery was above the QC limit.
- "e" indicates the RPD was above the QC limit.
- "f" indicates blank contamination.
- "g" indicates a tentatively identified compound.
- "h" indicates that the serial dilution exceeded the acceptance limit.
- "i" indicates that the serial dilution met the acceptance limit.
- "j" indicates that variability in analytical results was attributed to proximity of the analyte to the detection limit.

In the analytical tables in this section, the "mean" is the average of the result and duplicate values. All values, including those below the detection level (<) were averaged. If both sample and duplicate values were nondetected, or if one value was detected and the other was not, the mean is expressed as a nondetected value. If both values were detected, the mean is expressed as a detected value.

B2.1.3.1 Thermogravimetric Analysis. Thermogravimetric analysis measures the mass of a sample as its temperature is increased at a constant rate from ambient temperature to about 500 °C (930 °F). Nitrogen is passed over the sample during heating to remove any released gases. A decrease in the weight of a sample during TGA represents a loss of gaseous matter from the sample, through evaporation or through a reaction that forms gas phase products. The moisture content is estimated by assuming that all TGA sample weight loss up to a certain temperature (typically 150 to 200 °C [300 to 390 °F]) is caused by water evaporation. The temperature limit for moisture loss is chosen by the operator at an inflection point on the TGA plot. Other volatile matter fractions, if present, can often be differentiated by inflection points as well. Sample sizes ranged from 10 to 31 mg. Quality control tests included analyses of sample duplicates and laboratory control standards.

Samples 2SY-96-1 and 2SY-96-2 had mean values of 88.5 and 85.9 weight percent water. Sample 2SY-96-3 had a mean value of 72.3 weight percent water. These values are in concert with the type of sample recovered; the two supernatant samples (2SY-96-1 and 2SY-96-2) have higher weight percent water values than the sludge sample (2SY-96-3).

B2.1.3.2 Differential Scanning Calorimetry. In a DSC analysis, heat absorbed or emitted by a substance is measured while the sample is heated at a constant rate from ambient

emperature to about 500 °C (930 °F). Nitrogen is passed over the sample material to remove any gases being released. The onset temperature for an endothermic or exothermic event is determined graphically. Sample sizes were 7 to 24 mg. Quality control tests included analyses of sample duplicates and laboratory control standards.

No exothermic reactions were noted for any of the grab samples; therefore, all samples met the waste compatibility DQO exotherm-to-endotherm ratio criterion of less than one. The primary endothermic events, occurring from about 50 °C to about 150 °C (120 °F to 300 °F), were assumed to be caused by loss of free water.

B2.1.3.3 Total Organic Carbon. Total organic carbon was determined by means of furnace oxidation. Aliquots of the liquid samples were introduced into an 800 °C (1470 °F) furnace maintained under a flow of oxygen gas. Carbon present in the sample was converted to carbon dioxide that the oxygen stream carried through purifying traps. The carbon dioxide was collected and quantitated coulometrically. Quality control tests included analyses of sample duplicates, matrix spikes, laboratory blanks, and laboratory control standards.

Total organic carbon mean values ranged from 365 μg C/mL (2SY-96-1) to 1,020 μg C/mL (2SY-96-2). The mean TOC value for sample 2SY-96-3 was 5,630 μg C/mL.

B2.1.3.4 Total Inorganic Carbon. Total inorganic carbon (carbonate) concentrations were determined using the hot-persulfate oxidation method (LA-342-100). The sample was first acidified and heated to release the carbonate as carbon dioxide. The carbon dioxide was trapped in a weakly basic solution and titrated coulometrically. Quality control tests included analyses of sample duplicates, matrix spikes, laboratory blanks, and laboratory control standards.

For the supernatant samples, TIC mean values ranged from less than 1,490 μg C/mL (2SY-96-1) to 1,500 μg C/mL (2SY-96-2). The mean TIC value for sample 2SY-96-3 was 4,340 μg C/mL.

B2.1.3.5 Inductively Coupled Plasma/Atomic Emission Spectroscopy. Determination of metal concentrations using ICP/AES was performed on an acid dilution of an aliquot of sample. Quality control tests included analyses of sample duplicates, matrix spikes or serial dilutions, laboratory blanks, and laboratory control standards. The waste compatibility DQO and the SAP required the reporting of all ICP analytes, but only aluminum, iron, and sodium were required to meet QC requirements.

For samples 2SY-96-1 and 2SY-96-2, the mean values in μg/mL were as follows: aluminum, 1,970 and 5,110; iron, <5.05 and <10.1; and sodium, 34,800 and 46,900. For both supernatant samples; chromium, phosphorous, potassium, silicon, silver, and sulfur were found at levels greater than detection limits. In addition, cadmium and molybdenum were found at levels greater than detection limits in sample 2SY-96-2. The ICP analytes were not determined for sample 2SY-96-3.

B2.1.3.6 Ion-Chromatography Analytes. Anion (bromide, chloride, fluoride, nitrate, nitrite, oxalate, phosphate, and sulfate) concentrations were determined by means of ion chromatography. Aliquots of sample were first diluted with deionized water. The diluted sample was then injected into the chromatograph, separated by means of an anion-exchange column, and detected by a conductivity detector. Quality control tests included analyses of sample duplicates, matrix spikes, laboratory blanks, and laboratory control standards. The waste compatibility DQO and the SAP required measuring the full suite of inorganic IC analytes.

For samples 2SY-96-1 and 2SY-96-2, the mean values in μg/mL were: chloride, 835 and 1,430; fluoride, 1,080 and 597; nitrate, 42,700 and 48,200; nitrite, 6,440 and 14,500; phosphate, 8,910 and 3,990; and sulfate, 2,450 and 2,030. Results were also reported for sample 2SY-96-3 and for the analytes bromide and oxalate for all three samples.

B2.1.3.7 Gamma Energy Analysis. To determine the gamma-emitting radionuclides (^{60}Co, ^{137}Cs), an aliquot of sample was loaded into a sample vial and counted using a gamma counting system. Quality control tests included analyses of sample duplicates, laboratory blanks, and laboratory control standards.

The ^{137}Cs mean values for samples 2SY-96-1 and 2SY-96-2 were 12.3 and 36.8 μCi/mL. For these two samples, less-than values were reported for ^{60}Co. For sample 2SY-96-3, the mean value for ^{137}Cs was 24.4 μCi/mL; for ^{60}Co, it was 0.00791 μCi/mL.

B2.1.3.8 Strontium-90. Strontium-90 activity was determined in an aliquot of the composite sample after separation from other radionuclides using carbonate precipitation with a nonradioactive strontium carrier. Beta counting was used to determine the activity of the separated ^{90}Sr. Quality control tests included analyses of sample duplicates, matrix spikes or tracers, laboratory blanks, and laboratory control standards.

The ^{90}Sr mean values for samples 2SY-96-1 and 2SY-96-2 were 0.00123 and 0.00746 μCi/mL. For sample 2SY-96-3, the ^{90}Sr mean value was 3.17 μCi/mL.

B2.1.3.9 Plutonium-239/240. To determine $^{239/240}$Pu and ^{241}Am activities, a sample aliquot was acidified with nitric acid and loaded onto a column containing resin beads coated with octyl(phenyl)-N,N-diisobutylcarbamoyl methylphosphine oxide (CMPO). The multivalent transuranic ions were extracted into the CMPO; americium was then eluted from the column in one fraction and plutonium in a second fraction. The eluates were mounted for alpha counting. Quality control tests included analyses of sample duplicates, matrix spikes or tracers, laboratory blanks, and laboratory control standards.

The $^{239/240}$Pu mean values for samples 2SY-96-1 and 2SY-96-2 were $< 4.01 \times 10^{-6}$ and 1.52×10^{-5} μCi/mL. A $^{239/240}$Pu value was not reported for sample 2SY-96-3.

B2.1.3.10 Americium-241. See Section B2.1.3.9 for a description of the method and QC. The ^{241}Am mean values for samples 2SY-96-1 and 2SY-96-2 were $< 6.52 \times 10^{-6}$ and $< 8.26 \times 10^{-6}$ μCi/mL. An ^{241}Am value was not reported for sample 2SY-96-3.

B2.1.3.11 Free Hydroxide. Free hydroxide concentration was determined by titration of an aliquot of sample with a dilute nitric acid standard to an endpoint between pH 8 and 10 using an autotitrator. Barium chloride was added to the sample prior to the determination to precipitate possible interfering caustic anions. Quality control tests included analyses of sample duplicates, laboratory blanks, and laboratory control standards.

The free hydroxide mean results for samples 2SY-96-1, 2SY-96-2, and 2SY-96-3 were 1,650, 7,880, and 8,290 μg/mL, respectively.

B2.1.3.12 pH Measurement. Sample pH was determined using a glass pH electrode (LA-212-106). Quality control tests included analyses of sample duplicates and laboratory control standards. The pH for all three grab samples ranged from 11.9 to 12.4.

B2.1.3.13 Specific Gravity. Specific gravity was determined by weighing a sample aliquot of known volume. Quality control tests included analyses of sample duplicates and laboratory control standards. The mean specific gravity for both samples 2SY-96-1 and 2SY-96-2 was 1.08. Specific gravity was not reported for sample 2SY-96-3. The value of 1.08 meets the waste compatibility DQO criterion of less than 1.41.

B2.1.3.14 Ammonia. Ammonia concentration was measured in an aliquot of sample using an ammonia-selective electrode. A method of standard additions was used to quantify the ammonia in the sample. Quality control tests included analyses of matrix spikes, laboratory blanks, and laboratory control standards.

The ammonia mean value for sample 2SY-96-1 was less than 1.25 μg NH_3/mL. For sample 2SY-96-2, a single ammonia value of 74.8 μg NH_3/mL was determined. Ammonia was not determined in sample 2SY-96-3.

B2.2 JULY/AUGUST 1997 PUSH-MODE CORE SAMPLING EVENT

The *Tank 241-SY-102 Push Mode Core Sampling and Analysis Plan* (Sasaki 1997b) governed the July/August 1997 push mode core sampling of the sludge layer in tank 241-SY-102. Three work packages (LMHC 1997b, 1997c and 1997d) describe the riser preparation and sampling events, and Steen (1998) presents the analytical results from the core samples.

Sasaki (1997b) prescribed that the bottom 97 cm (38 in.) of the tank waste be sampled. Core 211 was obtained through riser 23A during July 23-28, 1997, and consisted of segments 11, 11R, and 12. Segment 11R was obtained when high downforces were encountered while taking segment 11 (LMHC 1997c). When obtained, the bottom of

segment 11R was at an elevation of about 48 cm (19 in.) from the tank bottom, and the bottom of segment 12 was at an elevation of approximately 0 cm from the tank bottom.

Core 213 was obtained through riser 17C during August 4-8, 1997, and consisted of segments 12R and 13. Segment 12R was taken after the sampler for segment 12 failed (LMHC 1997b). When acquired, the bottom of segment 12R was at an elevation of about 48 cm (19 in.) from the tank bottom, and the bottom of segment 13 was at an elevation of approximately 0 cm from the tank bottom.

At the time of the core sampling, the tank contained approximately 270 kL (71 kgal) of solids and 2,320 kL (612 kgal) of supernatant. Before the sampling, combustible gas meter readings were performed in the field to measure flammability in the tank headspace.

The core samples were delivered to the 222-S Laboratory for analysis. A sample of the lithium bromide-traced hydrostatic head fluid (HHF) was delivered with core 211, and a deionized-water field blank was delivered with core 213. The samples, field blanks, and HHF sample were analyzed in the laboratory from August 4, 1997, to November 4, 1997. Tables B2-7 and B2-8 present sampling, subsampling, and descriptive information for the two cores.

Table B2-7. Tank 241-SY-102 July/August 1997 Push Mode Core Subsampling Scheme and Sample Descriptions.[1] (2 sheets)

Riser	Sample ID	Weight (g)	Sample Portion	Description
Core 211, Riser 23A				
23A	211-11	273.1	Whole	250 mL opaque, yellow liquid. No separable layer. 16.2 g liner liquid recovered but not analyzed.
	211-11R	327.3	Drainable liquid	170 mL opaque, brown liquid. 25 cm (10 in.) medium-to-dark-brown solids with sludge/slurry consistency extruded. No separable layer.
			Upper half	
			Lower half	
	211-12	334.8	Drainable liquid	30 mL opaque, brown liquid. 41 cm (16 in.) medium-to-dark-brown solids with sludge/slurry consistency extruded. No separable layer.
			Upper half	
			Lower half	

Table B2-7. Tank 241-SY-102 July/August 1997 Push Mode Core Subsampling Scheme and Sample Descriptions.[1] (2 sheets)

Riser	Sample ID	Weight (g)	Sample Portion	Description
Core 213, Riser 17C				
17C	213-12R	285.1	Whole	250 mL opaque, yellow liquid. No separable layer.
	213-13	325.8	Upper half	170 mL opaque, brown liquid. 43 cm (17 in.) medium-to-dark-brown solids with sludge/slurry consistency extruded. No separable layer. 36 g liner liquid recovered but not analyzed.
			Lower half	

Note:

[1]Steen (1998)

Table B2-8. Tank 241-SY-102 July/August 1997 Push Mode Core Sample Information.[1]

Sample Numbers		Date	Date	Date	Sample Elevation[2]		Drill-string Dose Rate	
Field	Lab	Sampled	Received	Extruded	cm	(in.)	mSv/hr	(mrem/hr)
Core 211, Riser 23A								
211-11	S97T001967	7/23/97	8/12/97	8/14/97	48	(19)	1.58	(158)
211-11R	S97T001829	7/25/97	8/4/97	8/4/97	48	(19)	0.20	(20)
211-12	S97T001830	7/28/97	8/4/97	8/4/97	0	(0)	0.36	(36)
LiBr	S97T001832	7/28/97	8/4/97	n/a	n/a	n/a	<0.005	(<0.5)
Core 213, Riser 17C								
213-12R	S97T001965	8/4/97	8/12/97	8/14/97	48	(19)	2.5	(250)
213-13	S97T001966	8/8/97	8/12/97	8/14/97	0	(0)	4.5	(450)
Field blank	S97T001873	7/30/97	8/1/97	n/a	n/a	n/a	<0.005	(<0.5)

Notes:

mSv = millisieverts
mrem = millirem

[1]Steen (1998)

[2]Sample elevation is defined from the bottom of the tank to the bottom of the core segment. These sample elevations may have an estimated error of ±5 cm (±2 in.).

B2.2.1 Sample Handling (July/August 1997)

Sasaki (1997b) and Steen (1998) describe the sample handling for the July/August 1997 core samples. The 222-S Laboratory received the core samples between 2 and 20 days after the samples were acquired (see Table B2-7); the SAP requested delivery within three days of sampling (Sasaki 1997b). Upon extrusion, the samples were visually examined and photographed and any drainable liquid was collected. The drainable liquid was filtered to remove particulate solids. Aliquots of the filtered liquid were then taken and treated as required for subsequent analysis. The solids were divided into upper and lower half segments; each half segment was homogenized before further subsampling and analysis. Drainable liquid and solids that were not used for analysis were archived. Liquid recovered from the sample liners of samples 211-11 and 213-13 was not analyzed, and Steen (1998) does not indicate that the liner liquids were archived.

B2.2.2 Sample Analysis (July/August 1997)

The analyses performed on the core samples were those required by the SAP (Sasaki 1997b). The analyses required by the safety screening DQO included determination of thermal properties by DSC, moisture content by TGA, and content of fissile material by total alpha activity analysis. The SAP further required determination of $^{239/240}Pu$, ^{241}Am, and ammonia. Bromide was determined by means of IC and lithium by ICP to ascertain the extent, if any, of HHF intrusion into the sample; other IC and ICP analytes were reported as opportunistic analytes. All analyses were performed according to approved laboratory procedures. The samples, field blanks, and HHF sample were analyzed in the laboratory from August 4, 1997, to November 4, 1997. Table B2-9 outlines the analytes and analytical procedures used. Table B2-10 is a summary of the sample portions, sample numbers, and analyses performed on each sample.

Table B2-9. Tank 241-SY-102 Analytical Methods and Procedures for July/August 1997 Core Samples.[1] (2 sheets)

Analyte	Method	Procedure
Energetics	Differential scanning calorimeter	LA-514-114
Percent water	Thermogravimetric analysis	LA-514-114
Total alpha activity	Alpha proportional counter	LA-508-101
Flammable gas	Combustible gas analyzer	WHC-IP-0030 IH 1.4 and IH 2.1[2]
ICP/AES analytes	Inductively coupled plasma/atomic emission spectrometer	LA-505-151 LA-505-161
IC analytes (anions)	Ion chromatograph	LA-533-105

Table B2-9. Tank 241-SY-102 Analytical Methods and Procedures for July/August 1997 Core Samples.[1] (2 sheets)

Analyte	Method	Procedure
Plutonium-239/240	CMPO separation/alpha counter	LA-953-104
Americium-241Am	CMPO separation/alpha counter	LA-953-104
Isotopes by ICP/MS	Inductively coupled plasma/mass spectrometer	LT-506-101
Bulk density	Gravimetry	LO-160-103
Specific gravity	Gravimetry	LA-510-112
Ammonia	Ion-selective electrode	LA-631-001

Notes:
[1]Steen (1998)
[2]WHC (1992a) and WHC (1992b)

Table B2-10. Tank 241-SY-102 Sample Analysis Summary for July/August 1997 Core Samples.[1] (2 sheets)

Sample Field Number	Sample Portion	Lab Sample Number	Analyses
Core 211, Riser 23A			
211-11	Drainable liquid	S97T001972	SpG, DSC/TGA, total alpha activity
		S97T001973	ICP, IC, ammonia
		S97T001975	Ammonia (acid dilution)
211-11R	Drainable liquid	S97T001917	SpG, DSC/TGA, total alpha activity
		S97T001918	ICP, IC, ammonia
		S97T001919	Ammonia (acid dilution)
	Upper half	S97T001909	Bulk density
		S97T001910	DSC/TGA
		S97T001912	ICP, ICP/MS
		S97T001913	IC
		S97T001996	Total alpha activity, $^{239/240}$Pu, ^{241}Am
211-11R	Lower half	S97T001892	Bulk density
		S97T001893	DSC/TGA
		S97T001895	ICP, ICP/MS
		S97T001908	IC
		S97T001995	Total alpha activity, $^{239/240}$Pu, ^{241}Am

Table B2-10. Tank 241-SY-102 Sample Analysis Summary for July/August 1997 Core Samples.[1] (2 sheets)

Sample Field Number	Sample Portion	Lab Sample Number	Analyses
Core 211, Riser 23A (Cont'd)			
211-12	Drainable liquid	S97T001933	SpG, DSC/TGA, total alpha activity
		S97T001934	ICP, IC, ammonia
	Upper half	S97T001928	DSC/TGA
		S97T001929	ICP, ICP/MS
		S97T001930	IC
	Lower half	S97T001921	Bulk density
		S97T001922	DSC/TGA
		S97T001924	ICP, ICP/MS
		S97T001925	IC
		S97T001998	Total alpha activity, $^{239/240}Pu$, ^{241}Am
Core 213, Riser 17C			
213-12R	Drainable liquid	S97T001977	SpG, DSC/TGA, total alpha activity
		S97T001978	IC, ICP, ammonia
		S97T001979	Ammonia (acid dilution)
213-13	Upper half	S97T001985	DSC/TGA
		S97T001990	ICP, ICP/MS
		S97T001991	IC
	Lower half	S97T001981	Bulk density
		S97T001983	DSC/TGA
		S97T001987	Total alpha activity, $^{239/240}Pu$, ^{241}Am
		S97T001988	ICP, ICP/MS
		S97T001989	IC
LiBr (HHF) Sample, Field Blank			
LiBr sample	Whole	S97T001832	IC, ICP/AES
Field blank	Whole	S97T001873	SpG, DSC/TGA, ammonia, ICP/AES, IC, total alpha activity

Note:

[1]Steen (1998)

B2.2.3 Analytical Results (July/August 1997)

This section summarizes the sampling and analytical results associated with the July/August 1997 push mode core sampling and analysis of tank 241-SY-102. Table B2-11 indicates which tables contain the analytical results associated with this tank. Steen (1998) is the source of the analytical results.

Table B2-11. Analytical Tables for the Tank 241-SY-102 July/August 1997 Core Sample Results.

Analysis	Table Number
Headspace vapor results	B2-12
Inductively coupled plasma/atomic emission spectroscopy	B2-74 through B2-110
Ion chromatography	B2-111 through B2-118
Percent water by thermogravimetric analysis	B2-119
Bulk density	B2-120
Specific gravity	B2-121
Total alpha activity	B2-122
Plutonium-239/240	B2-123
Americium-241	B2-124
ICP/MS - thorium isotopes	B2-125 through B2-127
ICP/MS - uranium isotopes	B2-128 through B2-132
ICP/MS - neptunium-237	B2-133
ICP/MS - plutonium isotopes	B2-134 through B2-136
ICP/MS - plutonium-241/americium-241	B2-137
ICP/MS - americium-243/curium-243	B2-138
ICP/MS - plutonium-244/curium-244	B2-139
Ammonia	B2-140

The QC criteria governing the push mode core sampling and analysis of the waste in tank 241-SY-102 were specified in the SAP (Sasaki 1997b). Two QC samples were associated with the tank sampling: a deionized water field blank and a sample of the lithium bromide-traced HHF. Four QC parameters were also assessed in conjunction with laboratory analysis of the samples: laboratory standard recoveries, spike recoveries, duplicate analyses, and laboratory

blanks. Sample and duplicate pairs for which any QC parameter was outside the SAP-required limits are footnoted in the sample mean column of the data summary tables with an a, b, c, d, e, f, g, h, i, or j. Section B2.1.3 gives the key to these QC designators.

B2.2.3.1 Differential Scanning Calorimetry. In a DSC analysis, heat absorbed or emitted by a substance is measured while the sample is heated at a constant rate from ambient temperature to about 500 °C (930 °F). Nitrogen is passed over the sample material to remove any gases being released. The onset temperature for an endothermic or exothermic event is determined graphically. Sample sizes were 5 to 35 mg. Quality control tests included analyses of sample duplicates and laboratory control standards.

No exothermic reactions were noted for any core samples; therefore, all sample results were less than the safety screening DQO threshold value of 480 J/g (dry weight) for exothermic activity. No 95 percent upper confidence limits were computed for the DSC data. The primary endothermic events, occurring from about 50 °C to about 150 °C (120 °F to 300 °F), were assumed to be caused by loss of free water.

B2.2.3.2 Thermogravimetric Analysis. Thermogravimetric analysis measures the mass of a sample as its temperature is increased at a constant rate from ambient temperature to about 500 °C (930 °F). Nitrogen is passed over the sample during heating to remove any released gases. A decrease in the weight of a sample during TGA represents a loss of gaseous matter from the sample through evaporation or through a reaction that forms gas-phase products. The moisture content is estimated by assuming that all TGA sample weight loss up to a certain temperature (typically 150 to 200 °C [300 to 390 °F]) is caused by water evaporation. The temperature limit for moisture loss is chosen by the operator at an inflection point on the TGA plot. Other volatile matter fractions may be differentiated by inflection points as well. Quality control tests included analyses of sample duplicates and laboratory control standards.

For the solids, mean percent water values ranged from 39.4 weight percent (S97T001983, 213-13, lower half) to 76.2 weight percent (S97T001910, 211-11R, upper half). For the drainable liquids, mean percent water values ranged from 74.0 weight percent (S97T001933, 211-12) to 84.9 weight percent (S97T001972, 211-11).

B2.2.3.3 Total Alpha Activity. For liquid samples, total alpha activity measurements were performed on direct mounts of sample aliquots. Aliquots of solid samples were fused using a flux of potassium hydroxide in a nickel crucible, then dissolved in acid. The resulting solution was dried on a counting planchet and counted in an alpha proportional counter. Quality control requirements included laboratory control standards, spikes, laboratory blanks, and duplicate analyses. For the solids, the SAP required total alpha activity determinations of the lower half segments only.

For the solids, mean total alpha activity results ranged from 1.72 μCi/g (S97T001998, 211-12, lower half) to 91.0 μCi/g (S97T001995, 211-11R, lower half). For the drainable liquids, mean total alpha activity results were less than 0.0682 μCi/mL.

B2.2.3.4 Inductively Coupled Plasma/Atomic Emission Spectroscopy. Metal concentrations were determined using ICP/AES on an acid digest (solid samples) or acid dilution (liquid samples) of an aliquot of sample. The SAP requested the reporting of all ICP analytes, but only aluminum, chromium, iron, lithium, manganese, nickel, silicon, sodium, and uranium were required to meet QC criteria. Lithium was measured to determine the extent of any HHF contamination of the samples. Quality control requirements included analyses of sample duplicates, matrix spikes or serial dilutions, laboratory blanks, and laboratory control standards.

For the solids, mean values in μg/g ranged as follows: aluminum, 6,000 to 85,900; chromium, 1,120 to 22,000; iron, 5,740 to 29,600; lithium, 9.66 to 25.2; manganese, 2,020 to 8,340; nickel, 111 to 276; silicon, 965 to 1,800; sodium, 47,900 to 123,000; uranium, 295 to 2,270. For the drainable liquids, mean values in μg/mL ranged from: aluminum, 1,570 to 5,040; chromium, 649 to 952; iron, <20.1; lithium, <2.01 to 15.6; manganese, <4.01; nickel, <8.02; silicon, 57.5 to 123; sodium, 54,700 to 94,000; and uranium, <200. The presence of lithium in both the solids and liquids indicates possible HHF contamination of the samples.

B2.2.3.5 Ion-Chromatography Analytes. Anion (bromide, chloride, fluoride, nitrate, nitrite, oxalate, phosphate, and sulfate) concentrations were determined by IC. Aliquots of liquid sample were diluted with deionized water, and solid samples were digested with deionized water. The treated sample was then injected into the chromatograph, separated by means of an anion-exchange column, and detected using a conductivity detector. The SAP requested the reporting of all IC analytes; however, only bromide was required to meet the QC criteria. Bromide was measured to determine the extent of any HHF contamination of the samples. Quality control requirements included analyses of sample duplicates, matrix spikes, laboratory blanks, and laboratory control standards.

For the solids, mean bromide concentrations ranged from <510 μg/g (S97T001925, 211-12, lower half) to 2,380 μg/g (S97T001989, 213-13, lower half). For the drainable liquids, mean bromide concentrations ranged from 270 μg/mL (S97T001918, 211-11R) to 779 μg/mL (S97T001934, 211-12R). The presence of bromide in the both the solids and liquids indicates possible HHF contamination of the samples.

B2.2.3.6 Plutonium-239/240. To determine the $^{239/240}$Pu and ^{241}Am activities, aliquots of the solid samples were fused with a flux of potassium hydroxide in a nickel crucible, then dissolved in acid. An aliquot of the treated sample was loaded onto a column containing resin beads coated with CMPO. The multivalent transuranic ions were extracted into the CMPO; americium was then eluted from the column in one fraction and plutonium in a second fraction. The eluates were mounted for alpha counting. Quality control tests included analyses of sample duplicates, matrix spikes or tracers, laboratory blanks, and laboratory control standards. The SAP required $^{239/240}$Pu and ^{241}Am activity determinations for only the solids of the lower half segments.

The $^{239/240}$Pu mean values ranged from 0.283 μCi/g (S97T001998, 211-12, lower half) to 26.8 μCi/g (S97T001995, 211-11R, lower half).

B2.2.3.7 Americium-241. See Section B2.2.3.6 for a description of the ^{241}Am determination. The SAP required ^{241}Am activity determinations for only the solids of the lower half segments. The ^{241}Am mean values ranged from 1.6 μCi/g (S97T001998, 211-12, lower half) to 99.6 μCi/g (S97T001995, 211-11R, lower half).

B2.2.3.8 Inductively Coupled Plasma/Mass Spectrometry. Determination of isotopic concentrations using ICP/MS was performed on an acid digest of solid sample aliquots; ICP/MS was not required for the drainable liquids. The SAP requested the reporting of all ICP/MS analytes, but only the uranium and plutonium isotopes, ^{237}Np, and ^{241}Pu/^{241}Am, were required to meet QC criteria. Quality control requirements included analyses of sample duplicates, matrix spikes or serial dilutions, laboratory blanks, and laboratory control standards.

The range of mean values in μg/g for selected isotopes were as follows: ^{235}U, 2.35 to 16.9; ^{238}U, 249 to 2,500; ^{237}Np, 0.665 to 3.50; ^{239}Pu, 3.94 to 244; ^{240}Pu, 0.320 to 27.4; and ^{241}Pu/^{241}Am, 0.541 to 26.2.

B2.2.3.9 Bulk Density/Specific Gravity. The bulk density of solids and the specific gravity of liquids were determined by weighing sample aliquots of known volume. The SAP specified that bulk density be determined on the lower half of the core segment solids; no quality controls were specified for bulk density (Sasaki 1997b). Quality control tests applied to the determination of specific gravity included analyses of sample duplicates and laboratory control standards.

Bulk density values for the solids ranged from 1.22 g/mL (S97T001909, 211-11R, upper half) to 1.64 g/mL (S97T001921, 211-12, lower half, and S97T001981, 213-13, lower half). The mean specific gravity for the drainable liquids ranged from 1.11 (S97T001917, 211-11R) to 1.21 (S97T001933, 211-12).

B2.2.3.10 Ammonia. Ammonia concentration was measured in aliquots of acidified and nonacidified liquid samples using an ammonium-ion-selective electrode. A method of standard additions was used to quantify the ammonia in the sample. Quality control tests included analyses of matrix spikes, laboratory blanks, and laboratory control standards. Ammonia measurements were not required for solid samples. The ammonia mean values ranged from <10 μg NH_3/mL (S97T001934, 211-12) to 116 μg NH_3/mL (S97T001978, 213-12R).

B2.3 VAPOR-PHASE MEASUREMENT

Measurements of the headspace vapor phase in tank 241-SY-102 consist of 1) industrial health and safety field measurements during the July/August 1997 push mode core sampling and 2) a SHMS that is a permanent part of the surveillance equipment associated with tank 241-SY-102.

B2.3.1 Field Measurement Results (July/August 1997)

Before and during the July/August 1997 push mode core sampling of tank 241-SY-102, field measurements of the vapor phase in the tank headspace were taken. These measurements supported the safety screening DQO (Dukelow et al. 1995). The vapor phase field measurements were taken 6.1 m (20 ft) below the tops of risers 23A and 17C in the tank headspace; no gas samples were collected for laboratory analysis. The measurements were taken according to Industrial Health and Safety field procedures (WHC 1992a and WHC 1992b). Table B2-12 provides the results of these vapor phase measurements.

Table B2-12. Results of Headspace Measurements of Tank 241-SY-102, July 23 to August 14, 1997.[1]

Measurement	Results	
	Minimum	Maximum
Total organic carbon	0 ppm	8.1 ppm
Lower explosive limit	0% of lower explosive limit	1% of lower explosive limit
Oxygen	20.6%	21.1%
Ammonia	5 ppm	100 ppm

Note:
[1]WHC Industrial Health and Safety data sheets

B2.3.2 Standard Hydrogen Monitoring System Results

The SHMS is briefly described in Appendix A, Section A4.4. For the gaseous analytes hydrogen, methane, nitrous oxide, and ammonia, SHMS gas chromatography data were reported for February 5, 1998, through April 18, 1998. Hydrogen, methane, and nitrous oxide were reported as less than detectable. The estimated detection limit for hydrogen and

nitrous oxide is about 3 ppmv; the estimated detection limit for methane is about 10 ppmv (Schneider 1997). The ammonia concentration ranged from about 26 to 46 ppmv. These concentrations are in concert with the July/August 1997 field measurements reported in Table B2-12.

B2.4 DESCRIPTION OF HISTORICAL SAMPLING EVENTS

Two historical core samplings of tank 241-SY-102 have occurred: in 1990 (Tingey and Sasaki 1995) and in 1988 (Scheele and Peterson 1990 and Weiss 1990). Numerous grab samples have also been acquired during the operation of tank 241-SY-102; most of these samples were for process control and waste compatibility purposes and are not discussed further in this report.

B2.4.1 February/March 1990 Push-Mode Core Sampling

In February and March of 1990, two cores were taken from tank 241-SY-102 in support of retrieval, pretreatment, vitrification and grout process development activities (Tingey and Sasaki 1995). Two cores, 16 and 17, were obtained through riser 13A. Each core consisted of 4 segments. The sampler failed on core 17, segment 3; therefore, segment 3R was obtained from the same riser at the segment 3 depth. The top two segments of each core consisted of supernatant; because tank 241-SY-102 is an active tank, the supernatant analytical results are not likely representative of the current tank contents and are not presented in this TCR.

B2.4.1.1 Sample Handling (1990). Tingey and Sasaki (1995) describe the extrusion and sample handling of the 1990 push mode cores. Core 16 was sent to the 222-S Laboratory for analyses to support pretreatment development. Core 17 was sent to the Pacific Northwest National Laboratory 325 Laboratory for characterization and analysis. During extrusion of core 17 at the 325 Laboratory, the cohesiveness of this core's sludge segments were observed to be more fluid than those of core 16. Because both cores were taken inches apart in the same riser, the sampling of core 16 was suspected to have disturbed the solid and liquid phases, thus causing core 17 to be more fluid. Hence, a 50-g composite of segments 3 and 4 from core 16 was prepared at the 222-S Laboratory and sent to the 325 Laboratory for characterization. Analysis of the core 16 composite was in addition to the core 17 characterization.

Segments 1 and 2 of core 16 were described as clear liquids with no visible solids; a separable organic layer was present in segments 1 and 2. Because normal paraffin hydrocarbon (NPH) was used as the HHF during the sampling operation, the organic layer may have originated from the NPH HHF. When the sampler for core 16, segment 3, was opened, a portion of the sample spurted onto the hot cell wall. Core 16, segment 3, was described as consisting of a dark brown liquid with about 18 cm (7 in.) of dark brown, pudding-like solids; the solids

apparently slumped upon standing in the extruder tray. All segment 3 drainable liquid and solids were composited together for analysis.

Core 16, segment 4, was described as consisting of a dark brown solid with a few white streaks. The bottom 25 cm (10 in.) of the segment was solid, while the top 15 cm (6 in.) had a softer, pudding-like consistency; the solids apparently slumped upon standing in the extruder tray. All solids in segment 4 were composited together for analysis. A composite of segment 3 and 4 material was also generated; 50 g of this composite was submitted to the 325 Laboratory for analysis.

Core 17 was extruded, prepared, and analyzed at the 325 Laboratory. Segments 1 and 2 of core 17 were liquid; these two segments were composited together and then centrifuged to separate the solid and liquid phases. Chemical and radiochemical analyses were performed on the liquid fraction; no results were reported for the solid fraction. The historical results for the liquid fraction of the segments 1 and 2 composite are not included here because of the transient nature of the supernatant layer in tank 241-SY-102.

Core 17, segment 3R, was described as a brown-black, runny/watery mud. Core 17, segment 4, had a similar description for the first 25 cm (10 in.) of the segment, followed by a 5-cm (2-in.) chunk of more solid material, followed again by material similar to the first 25 cm. The 5-cm chunk was archived for rheology measurements. Segment 3 and the remainder of segment 4 from core 17 were composited together, and the composite was centrifuged to separate the liquid and solid phases. Chemical and radiochemical analyses were performed separately on the two phases. The 50-g composite sample from core 16 was also centrifuged, and the liquid and solid fractions analyzed at the 325 Laboratory. Tingey and Sasaki (1995) do not report the volume percent or weight percent values for the centrifuged solids and liquids that resulted from centrifuging the samples.

Tables B2-13 and B2-14 summarize the sample descriptions and sample breakdown scheme for cores 16 and 17.

Table B2-13. Tank 241-SY-102 February/March 1990
Push Mode Core Sample Information.[1]

Segment Number	Field Sample Number	Date Sampled	Date Received	Date Extruded	Sample Elevation[2]		Drill String Dose Rate (mRad/hr)
					cm	(in.)	
Core 16, Riser 13A							
1	90-001	2/21/90	N/A	3/14/90	145	(57)	N/A
2	90-002	2/21/90	N/A	3/14/90	97	(38)	N/A
3	90-003	2/21/90	N/A	3/14/90	48	(19)	N/A
4	90-004	2/21/90	N/A	3/13/90	0	(0)	N/A
Core 17, Riser 13A[3]							
1	90-005	3/7/90	3/19/90	4/4/90	145	(57)	15
2	90-006	3/7/90	3/19/90	4/4/90	97	(38)	34
3R	90-007R	3/13/90	3/20/90	4/4/90	48	(19)	200
4	90-008	3/14/90	3/20/90	4/4/90	0	(0)	800

Notes:

N/A = not available

[1]Tingey and Sasaki (1995), 222-S Laboratory extrusion data sheets

[2]Sample elevation is defined as the distance from the tank bottom to the bottom of the core segment.

[3]Parts of Tingey and Sasaki (1995) identify the core 17 segments as 1, 2, 3R, and 4; the chain-of-custody forms identify these same segments as 5, 6, 7R, and 8, respectively.

Table B2-14. Tank 241-SY-102 February/March 1990 Push Mode Core Subsampling Scheme and Sample Descriptions.[1]

Segment Number	Field Sample Number	Sample Portion	Weight (g)	Description
Core 16, Riser 13A				
1	90-001	Whole	128.84	Clear liquid, no visible solids. Visible organic layer (possibly NPH HHF). 15 mL liner liquid recovered.
2	90-002	Whole	190.92	Clear liquid, no visible solids. Visible organic layer (possibly NPH HHF). 10 mL liner liquid recovered.
3	90-003	Whole	216.95	Approximately 200 mL drainable liquid and about 18 cm (7 in.) dark brown, pudding-like solids. Whole sample combined in sample jar. 10 mL liner liquid recovered. Sampler was pressurized and spurt on hot cell wall when sample valve opened
4	90-004	Whole	259.16	Dark-brown with some white streaks, top 15 cm (6 in.) soft and pudding-like, bottom 25 cm (10 in.) more solid. 10 mL liner liquid recovered.
Core 17, Riser 13A[2]				
1	90-005	Drainable liquid	102	Clear liquid; 100 mL liner liquid also recovered.
		Solids	0	
2	90-006	Drainable liquid	207	Liquid; 70 mL liner liquid also recovered.
		Solids	0	
3R	90-007R	Drainable liquid	125	Brown-black, runny/watery mud-like solids; 25 mL liner liquid also recovered.
		Solids	148	
4	90-008	Drainable liquid	31	Brown-black, runny/watery mud-like solids; first 25 cm (10 in.) of segment appeared as "dilute mud" followed by ca. 5 cm (2 in.) of more solid portion which in turn was followed by more "dilute mud." 25 mL liner liquid also recovered.
		Solids	311	

Notes:

[1]Tingey and Sasaki (1995), 222-S Laboratory extrusion data sheets

[2]Parts of Tingey and Sasaki (1995) identify the core 17 segments as 1, 2, 3R, and 4; the chain-of-custody forms identify these same segments as 5, 6, 7R, and 8, respectively.

B2.4.1.2 Sample Analysis (1990). The metals and most radionuclides were determined on fused samples of sludge. Two fusion methods were used: 1) a potassium hydroxide flux in nickel crucibles and 2) a sodium peroxide flux in zirconium crucibles. The resulting fused samples were dissolved in acid and analyzed. The method for preparing samples to determine anions in solids was not identified. Liquid samples were analyzed either directly or after dilution with acid or water.

Metals were determined using ICP/AES. Anions were determined by IC. Various separations and counting methods were used before determining the activities of individual radionuclides. Alpha proportional counting was used to determine total alpha activity; beta proportional counting was used to determine total beta activity. Strontium-90 activity was determined using beta proportional counting. Gamma energy analysis was used to determine ^{60}Co, ^{94}Nb, ^{137}Cs, ^{144}Ce, ^{154}Eu, and ^{155}Eu activities. The activities of the transuranic species ^{237}Np, ^{238}Pu, $^{239/240}Pu$, ^{241}Am, and $^{243/244}Cm$ were determined by means alpha proportional counting and alpha energy analysis. Liquid scintillation counting was used to measure the activities of ^{3}H, ^{14}C, ^{79}Se, and ^{99}Tc.

Laboratory quality control included the use of laboratory method blanks, laboratory control standards, sample duplicates, sample spikes, and sample dilutions. For the ICP analyses, QC consisted of method blanks and sample dilutions; no data were reported for sample duplicates, spikes, or laboratory control standard recoveries. For the IC analyses, method blanks were used; no data were reported that indicated the use of duplicates or sample spikes. Quality control for the chromium (VI) determination consisted of blanks, sample spikes, and laboratory control standards. Ammonia determinations incorporated laboratory control standards, blanks, and sample spikes. For the TIC/TOC and ^{14}C determinations, duplicate sample analyses were reported; no other QC data were included. Only method blank data were reported with the remaining radionuclide results.

Tables B2-162 through B2-167 list the analytical results for the February/March 1990 core samples.

B2.4.2 October 1988 Push Mode Core Sampling

The samples and most of the data reported in this section were acquired before May 1989 and are presented for information only. Scheele and Peterson (1990) and Weiss (1990) present sampling information and analytical results from the October 1988 core samples. Onishi et al. (1996) presents extensive physical characterization and some additional chemical characterization of an aliquot of archived solids from this sampling event. Because tank 241-SY-102 is an active tank, the supernatant analytical results from this core sampling effort are not likely representative of the current tank contents and are not presented in this TCR.

In October 1988, a single four-segment core was obtained from riser 1B (Scheele and Peterson 1990). The four segments were taken from the bottom 193 cm (76 in.) of the tank waste. Segments 1 and 2 were liquid; segments 3 and 4 contained solids with segment 3 being a very fluid slurry. A description of the samples recovered is provided in Table B2-15.

Table B2-15. Tank 241-SY-102 October 1988 Push-Mode Core Sample Descriptions.[1]

Segment Number	Expected Length cm (in.) (matrix)	Actual Recovered Length cm (in.) (matrix)	Weight Solid Recovered (g)	Drill String Dose Rate (mRad/hr)
1	48.3 (19.0) (Liquid)	48.3 (19.0) (Liquid)	0	5.00
2	48.3 (19.0) (Liquid)	25.4 (10.0) (Liquid)	0	10.0
3	48.3 (19.0) (Solid)	48.3 (19.0) (Liquid/solid)	222	23.0
4	48.3 (19.0) (Solid)	38.1 (15.0) (Solid)	285	n/r

Note:
[1]Scheele and Peterson (1990)

B2.4.2.1 Sample Handling (1988). The October 1988 core segments were extruded and subsampled in the 222-S Laboratory 1E-2 hot cell, then analyzed at the 222-S and the 325 Laboratories. Table B2-16 describes the subsampling scheme. Segments 1 and 2 contained only liquid and were combined. Segment 3 was homogenized, and 15 mL was sent to the 325 Laboratory. Segment 4 was selected for physical analysis and was subdivided into top and bottom sections. The top section of segment 4 was homogenized and a 20-mL portion was sent to the 325 Laboratory; the bottom section also was transferred to the 325 Laboratory with minimal handling for rheological measurements. The remaining waste from segment 3 and the top of segment 4 was composited together and centrifuged to separate the liquid and solid portions.

Table B2-16. Subsampling Scheme for the October 1988 Push Mode Core Sample.
(2 sheets)

Sample ID	Sample Description
102-SY-1-2	Supernatant, composite of segments 1 and 2. These were yellow liquids.
102-SY-3C	Segment 3. Slurry containing dark brown fine solids.
102-SY-3T4S	Centrifuged solids from the composite of segment 3 and the top portion of segment 4. Fine, dark brown solids.

Table B2-16. Subsampling Scheme for the October 1988 Push Mode Core Sample. (2 sheets)

Sample ID	Sample Description
102-SY-3T4L	Centrifuged supernatant from the composite of segment 3 and the top portion of segment 4. Yellow liquids.
102-SY-T4C	Top portion of segment 4. Fine, dark brown solids.
102-SY-4B	Bottom portion of segment 4.

B2.4.2.2 Sample Analysis (1988). Supernatant sample 102-SY-1-2, the composite of segments 1 and 2, was analyzed for ICP metals, IC anions, TOC, percent water, specific gravity, ^{14}C, ^{90}Sr, ^{137}Cs, and $^{239/240}Pu$. Scheele and Peterson (1990) and Weiss (1990) report the results of these analyses; the results are not reproduced here because they likely no longer reflect the current composition of the supernatant in tank 241-SY-102.

Tables B2-168 through B2-170 present the results of the chemical and radiochemical measurements for the solids portions of the October 1988 push mode core samples. The solids, particularly the bottom of segment 4, received more extensive analysis for anions and radionuclides. Anion analyses on the sludge were conducted only on segment 4. Ion chromatography, chromium (VI), and tritium determinations were performed on a water digest of the sludge.

The Pacific Northwest National Laboratory performed X-ray diffraction on some sample 102-SY-T4C and 102-SY-4B solids to determine iron crystallinity in the solids (Scheele and Peterson 1990). The X-ray diffraction samples were prepared by washing the centrifuged solids with deionized water to remove most of the soluble salts. The remaining crystalline phases were aluminum silicate hydroxide, aluminum silicate hydroxide hydrate, magnesium silicate hydroxide, and uranyl nitrate. Crystalline aluminum hydroxide and crystalline iron compounds were not detected.

The following physical parameters of the core sample sludge were determined: density, volume percent settled solids, weight-percent water, weight-percent oxides, and, for the centrifuged samples, the volume- and weight-percent solids. Table B2-171 presents these results.

Additional physical and rheological characterization of sample 102-SY-4B included shear strength, penetration resistance, settling behavior, and particle size distribution (Scheele and Peterson 1990). The sample's shear strength was determined to be 3,900 Pa (39,000 dynes/cm^2). Sample 102-SY-4B exhibited a penetration resistance of 76 kPa (11 psi); the sample was concluded to exhibit cohesive properties. The settling behavior was determined for 1:1 and 2:1 deionized water:sample dilutions; the 1:1 dilution completely

settled in 27 hours, and the 2:1 dilution completely settled in 24 hours. Particle-size analysis of sample 102-SY-4B revealed that the majority of the particles were in the 10- to 20-μm-diameter range based on number of particles, and in the 50- to 60-μm-diameter range based on volume.

Shear stress versus shear rate measurements were also made on the 1:1 and 2:1 deionized water:sample dilutions of sample 102-SY-4B (Scheele and Peterson 1990). The rheograms for both dilutions showed that they exhibited pseudoplastic behavior. Neither slurry exhibited a yield stress. The data from the rheograms were least-squares fit to a power law model:

$$\tau = \tau_y + k\gamma^n$$

where τ = shear stress (Pascal), τ_y = yield point (Pascal), k = consistency factor (Pascal-second), γ = shear rate (1/second), and n = flow behavior index (unitless). Table B2-172 shows the power law curve fit parameters. The power law model describes the change in shear stress as a function of shear rate and the flow behavior index, and yields the necessary parameters for the yield-pseudoplastic rheological model. For additional information and discussion on the power law model, refer to DeLorenzo et al. (1994).

The rheological parameters, along with the density of the dilutions, were used to obtain the critical Reynolds Number and the critical velocity for transferring the slurries in 3-in. and 2-in.-diameter pipes. The results are summarized in Table B2-173.

Onishi et al. (1996) reports extensive additional physical characterization and some additional chemical characterization of an aliquot of archived solids from the October 1988 core sampling event. The document identifies the tank 241-SY-102 sludge sample with LABCORE sample number S96R000511; this sample number was traced to sample 102-SY-3C. The document presents particle size distribution, zeta potential, rheology, and sedimentation rate data. The morphology of the particles in the solids was determined using transmission electron microscopy. Chemical composition of the solids was determined using electron energy dispersive spectroscopy, and mineral composition was determined by means of electron diffraction. Finally, the document presents the results of modeling the jet-pump mixing of the sludge layer with the supernatant layer for waste retrieval purposes.

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Table B2-17. Tank 241-SY-102 Analytical Results: Aluminum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	1,970	1,960	1,970
S97T000026		Grab sample	5,120	5,090	5,110

Table B2-18. Tank 241-SY-102 Analytical Results: Antimony (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<6.06	<6.06	<6.06
S97T000026		Grab sample	<12.1	<12.1	<12.1

Table B2-19. Tank 241-SY-102 Analytical Results: Arsenic (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<10.1	<10.1	<10.1
S97T000026		Grab sample	<20.1	<20.1	<20.1

Table B2-20. Tank 241-SY-102 Analytical Results: Barium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<5.05	<5.05	<5.05
S97T000026		Grab sample	<10.1	<10.1	<10.1

Table B2-21. Tank 241-SY-102 Analytical Results: Beryllium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<0.505	<0.505	<0.505
S97T000026		Grab sample	<1.01	<1.01	<1.01

Table B2-22. Tank 241-SY-102 Analytical Results: Bismuth (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<10.1	<10.1	<10.1
S97T000026		Grab sample	<20.1	<20.1	<20.1

Table B2-23. Tank 241-SY-102 Analytical Results: Boron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<5.05	<5.05	<5.05
S97T000026		Grab sample	<10.1	10.1	<10.1

Table B2-24. Tank 241-SY-102 Analytical Results: Cadmium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<0.505	<0.505	<0.505
S97T000026		Grab sample	1.34	1.39	1.37

Table B2-25. Tank 241-SY-102 Analytical Results: Calcium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<10.1	<10.1	<10.1
S97T000026		Grab sample	<20.1	<20.1	<20.1

Table B2-26. Tank 241-SY-102 Analytical Results: Cerium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<10.1	<10.1	<10.1
S97T000026		Grab sample	<20.1	<20.1	<20.1

Table B2-27. Tank 241-SY-102 Analytical Results: Chromium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	369	368	369
S97T000026		Grab sample	948	937	943

Table B2-28. Tank 241-SY-102 Analytical Results: Cobalt (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<2.02	<2.02	<2.02
S97T000026		Grab sample	<4.02	<4.02	<4.02

Table B2-29. Tank 241-SY-102 Analytical Results: Copper (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<1.01	<1.01	<1.01
S97T000026		Grab sample	<2.01	<2.01	<2.01

Table B2-30. Tank 241-SY-102 Analytical Results: Iron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<5.05	<5.05	<5.05
S97T000026		Grab sample	<10.1	<10.1	<10.1

Table B2-31. Tank 241-SY-102 Analytical Results: Lanthanum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<5.05	<5.05	<5.05
S97T000026		Grab sample	<10.1	<10.1	<10.1

Table B2-32. Tank 241-SY-102 Analytical Results: Lead (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<10.1	<10.1	<10.1
S97T000026		Grab sample	<20.1	<20.1	<20.1

Table B2-33. Tank 241-SY-102 Analytical Results: Lithium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<1.01	<1.01	<1.01
S97T000026		Grab sample	<2.01	<2.01	<2.01

Table B2-34. Tank 241-SY-102 Analytical Results: Magnesium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<10.1	<10.1	<10.1
S97T000026		Grab sample	<20.1	<20.1	<20.1

Table B2-35. Tank 241-SY-102 Analytical Results: Manganese (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<1.01	<1.01	<1.01
S97T000026		Grab sample	<2.01	<2.01	<2.01

Table B2-36. Tank 241-SY-102 Analytical Results: Molybdenum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<5.05	<5.05	<5.05
S97T000026		Grab sample	11.5	10.9	11.2

Table B2-37. Tank 241-SY-102 Analytical Results: Neodymium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<10.1	<10.1	<10.1
S97T000026		Grab sample	<20.1	<20.1	<20.1

Table B2-38. Tank 241-SY-102 Analytical Results: Nickel (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<2.02	<2.02	<2.02
S97T000026		Grab sample	<4.02	<4.02	<4.02

Table B2-39. Tank 241-SY-102 Analytical Results: Phosphorus (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	3,190	3,190	3,190
S97T000026		Grab sample	1,360	1,340	1,350

Table B2-40. Tank 241-SY-102 Analytical Results: Potassium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	807	792	800
S97T000026		Grab sample	2,130	2,070	2,100

Table B2-41. Tank 241-SY-102 Analytical Results: Samarium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<10.1	<10.1	<10.1
S97T000026		Grab sample	<20.1	<20.1	<20.1

Table B2-42. Tank 241-SY-102 Analytical Results: Selenium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<10.1	<10.1	<10.1
S97T000026		Grab sample	<20.1	<20.1	<20.1

Table B2-43. Tank 241-SY-102 Analytical Results: Silicon (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	8.17	8.31	8.24
S97T000026		Grab sample	17.7	16.7	17.2

Table B2-44. Tank 241-SY-102 Analytical Results: Silver (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	2.39	2.51	2.45
S97T000026		Grab sample	3.43	3.30	3.37

Table B2-45. Tank 241-SY-102 Analytical Results: Sodium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	34,900	34,700	34,800
S97T000026		Grab sample	47,000	46,800	46,900

Table B2-46. Tank 241-SY-102 Analytical Results: Strontium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<1.01	<1.01	<1.01
S97T000026		Grab sample	<2.01	<2.01	<2.01

Table B2-47. Tank 241-SY-102 Analytical Results: Sulfur (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	747	751	749
S97T000026		Grab sample	562	561	562

Table B2-48. Tank 241-SY-102 Analytical Results: Thallium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<20.2	<20.2	<20.2
S97T000026		Grab sample	<40.2	<40.2	<40.2

Table B2-49. Tank 241-SY-102 Analytical Results: Titanium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<1.01	<1.01	<1.01
S97T000026		Grab sample	<2.01	<2.01	<2.01

Table B2-50. Tank 241-SY-102 Analytical Results: Total Uranium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<50.5	<50.5	<50.5
S97T000026		Grab sample	<100	<100	<100

Table B2-51. Tank 241-SY-102 Analytical Results: Vanadium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<5.05	<5.05	<5.05
S97T000026		Grab sample	<10.1	<10.1	<10.1

Table B2-52. Tank 241-SY-102 Analytical Results: Zinc (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<1.01	<1.01	<1.01
S97T000026		Grab sample	<2.01	<2.01	<2.01

Table B2-53. Tank 241-SY-102 Analytical Results: Zirconium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<1.01	<1.01	<1.01
S97T000026		Grab sample	<2.01	<2.01	<2.01

Table B2-54. Tank 241-SY-102 Analytical Results: Bromide (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	<644	<644	<644
S97T000026		Grab sample	<265	<265	<265
S97T000027		Grab sample	<265	<265	<265

Table B2-55. Tank 241-SY-102 Analytical Results: Chloride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	805	866	835
S97T000026		Grab sample	1,410	1,460	1,430
S97T000027		Grab sample	1,110	1,130	1,120

Table B2-56. Tank 241-SY-102 Analytical Results: Fluoride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	1,100	1,070	1,080
S97T000026		Grab sample	647	546	597
S97T000027		Grab sample	452	453	452

Table B2-57. Tank 241-SY-102 Analytical Results: Nitrate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	42,500	42,900	42,700
S97T000026		Grab sample	48,700	47,800	48200[QC:c]
S97T000027		Grab sample	37,800	37,900	37,900

Table B2-58. Tank 241-SY-102 Analytical Results: Nitrite (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	6,410	6,480	6,440
S97T000026		Grab sample	14,600	14,500	14,500
S97T000027		Grab sample	15,400	15,500	15,400

Table B2-59. Tank 241-SY-102 Analytical Results: Phosphate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	8,800	9,020	8,910
S97T000026		Grab sample	4,020	3,960	3,990
S97T000027		Grab sample	4,400	4,470	4,430

Table B2-60. Tank 241-SY-102 Analytical Results: Sulfate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T000024	Riser 1A	Grab sample	2,400	2,510	2,450
S97T000026		Grab sample	1,790	2,280	2,030[QC:e]
S97T000027		Grab sample	2,190	2,340	2,260

Table B2-61. Tank 241-SY-102 Analytical Results: Oxalate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000024	Riser 1A	Grab sample	<541	<541	<541
S97T000026		Grab sample	<223	<223	<223
S97T000027		Grab sample	579	553	566

Table B2-62. Tank 241-SY-102 Analytical Results: Percent Water (DSC/TGA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**wt%**	**wt%**	**wt%**
S97T000024	Riser 1A	Grab sample	88.6	88.4	88.5
S97T000026		Grab sample	85.8	85.9	85.9
S97T000027		Grab sample	72.0	72.5	72.3

Table B2-63. Tank 241-SY-102 Analytical Results: pH Measurement.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**unitless**	**unitless**	**unitless**
S97T000024	Riser 1A	Grab sample	12.1	12.1	12.1
S97T000026		Grab sample	12.0	11.9	11.9
S97T000027		Grab sample	12.4	12.4	12.4

Table B2-64. Tank 241-SY-102 Analytical Results: Specific Gravity.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**unitless**	**unitless**	**unitless**
S97T000024	Riser 1A	Grab sample	1.08	1.09	1.08
S97T000026		Grab sample	1.07	1.08	1.08

Table B2-65. Tank 241-SY-102 Analytical Results: Cobalt-60 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µCi/mL**	**µCi/mL**	**µCi/mL**
S97T000025	Riser 1A	Grab sample	<3.04E-04	<3.22E-04	<3.13E-04
S97T000028		Grab sample	<8.86E-04	<0.00105	<9.68E-04
S97T000029		Grab sample	0.00531	0.0105	0.00791[QC:e]

Table B2-66. Tank 241-SY-102 Analytical Results: Cesium-137 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µCi/mL**	**µCi/mL**	**µCi/mL**
S97T000025	Riser 1A	Grab sample	12.3	12.2	12.3
S97T000028		Grab sample	37.0	36.5	36.8
S97T000029		Grab sample	24.5	24.2	24.4

Table B2-67. Tank 241-SY-102 Analytical Results: Strontium-89/90.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µCi/mL**	**µCi/mL**	**µCi/mL**
S97T000025	Riser 1A	Grab sample	9.29E-04	0.00154	0.00123[QC:e]
S97T000028		Grab sample	0.00766	0.00726	0.00746
S97T000029		Grab sample	3.10	3.25	3.17

Table B2-68. Tank 241-SY-102 Analytical Results: Plutonium-239/240.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µCi/mL**	**µCi/mL**	**µCi/mL**
S97T000025	Riser 1A	Grab sample	<3.81E-06	<4.21E-06	<4.01E-06
S97T000028		Grab sample	1.53E-05	1.51E-05	1.52E-05

Table B2-69. Tank 241-SY-102 An. ical Results: Americium-241.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
S97T000025	Riser 1A	Grab sample	<6.87E-06	<6.17E-06	<6.52E-06
S97T000028		Grab sample	<9.16E-06	<7.36E-06	<8.26E-06

Table B2-70. Tank 241-SY-102 Analytical Results: Total Organic Carbon (Furnace Oxidation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Triplicate	Mean
Liquids			µg C/mL	µg C/mL	µg C/mL	µg C/mL
S97T000024	Riser 1A	Grab sample	290	472	332	365[QC:e]
S97T000026		Grab sample	1,030	1,010	n/a	1,020
S97T000027		Grab sample	5,650	4,640	6,590	5,630

Table B2-71. Tank 241-SY-102 Analytical Results: Total Inorganic Carbon.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg C/mL	µg C/mL	µg C/mL
S97T000024	Riser 1A	Grab sample	<1,460	1,510	<1,490
S97T000026		Grab sample	1,480	1,510	1,500
S97T000027		Grab sample	4,190	4,490	4,340

Table B2-72. Tank 241-SY-102 Analytical Results: Ammonia. (Ion Selective Electrode [NH_3]).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg NH_3/mL	µg NH_3/mL	µg NH_3/mL
S97T000024	Riser 1A	Grab sample	<1.00	1.50	<1.25
S97T000026		Grab sample	74.8	n/a	74.8

Table B2-73. Tank 241-SY-102 Analytical Results: Hydroxide (OH Direct).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T000024	Riser 1A	Grab sample	1,680	1,610	1,650
S97T000026		Grab sample	7,980	7,770	7,880
S97T000027		Grab sample	7,980	8,590	8,290

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Table B2-74. Tank 241-SY-102 Analytical Results: Aluminum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	6,090	5,910	6,000
S97T001895		Lower half	7,750	7,650	7,700
S97T001929	211:12	Upper half	34,500	39,500	37,000
S97T001924		Lower half	36,600	36,800	36,700[QC:c]
S97T001990	213:13	Upper half	86,100	85,700	85,900
S97T001988		Lower half	17,800	20,800	19,300[QC:d]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	5,050	5,030	5,040
S97T001918	211:11R	Drainable liquid	3,890	3,970	3,930
S97T001934	211:12	Drainable liquid	1,570	1,560	1,570
S97T001978	213:12R	Drainable liquid	3,690	3,700	3,700

Table B2-75. Tank 241-SY-102 Analytical Results: Antimony (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	< 12	< 12	< 12
S97T001895		Lower half	< 24	< 24	< 24
S97T001929	211:12	Upper half	< 24	< 23.9	< 23.9
S97T001924		Lower half	< 24	< 24	< 24
S97T001990	213:13	Upper half	< 12	< 12	< 12
S97T001988		Lower half	< 11.9	< 12	< 11.9
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	< 12.1	< 12.1	< 12.1
S97T001918	211:11R	Drainable liquid	< 24.1	< 24.1	< 24.1
S97T001934	211:12	Drainable liquid	< 24.1	< 24.1	< 24.1
S97T001978	213:12R	Drainable liquid	< 12.1	< 12.1	< 12.1

Table B2-76. Tank 241-SY-102 Analytical Results: Arsenic (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	<20	<20	<20
S97T001895		Lower half	<40	<40	<40
S97T001929	211:12	Upper half	<40	<39.9	<40
S97T001924		Lower half	<39.9	<40	<40
S97T001990	213:13	Upper half	<19.9	<19.9	<19.9
S97T001988		Lower half	<19.9	<20	<19.9
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<20.1	<20.1	<20.1
S97T001918	211:11R	Drainable liquid	<40.1	<40.1	<40.1
S97T001934	211:12	Drainable liquid	<40.1	<40.1	<40.1
S97T001978	213:12R	Drainable liquid	<20.1	<20.1	<20.1

Table B2-77. Tank 241-SY-102 Analytical Results: Barium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	26.3	25.2	25.8
S97T001895		Lower half	47.2	46.5	46.9
S97T001929	211:12	Upper half	21.4	21.9	21.6
S97T001924		Lower half	<20	<20	<20
S97T001990	213:13	Upper half	19.9	20.0	19.9
S97T001988		Lower half	41.9	44.0	43.0
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<10.1	<10.1	<10.1
S97T001918	211:11R	Drainable liquid	<20.1	<20.1	<20.1
S97T001934	211:12	Drainable liquid	<20.1	<20.1	<20.1
S97T001978	213:12R	Drainable liquid	<10.1	<10.1	<10.1

Table B2-78. Tank 241-SY-102 Analytical Results: Beryllium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	2.03	2.04	2.04
S97T001895		Lower half	5.94	5.96	5.95
S97T001929	211:12	Upper half	<2	<1.99	<2
S97T001924		Lower half	<2	<2	<2
S97T001990	213:13	Upper half	1.13	1.16	1.15
S97T001988		Lower half	2.78	2.94	2.86
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<1.01	<1.01	<1.01
S97T001918	211:11R	Drainable liquid	<2	<2	<2
S97T001934	211:12	Drainable liquid	<2	<2	<2
S97T001978	213:12R	Drainable liquid	<1.01	<1.01	<1.01

Table B2-79. Tank 241-SY-102 Analytical Results: Bismuth (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	4,870	4,570	4,720
S97T001895		Lower half	424	385	405
S97T001929	211:12	Upper half	300	300	300
S97T001924		Lower half	152	153	153
S97T001990	213:13	Upper half	375	382	379
S97T001988		Lower half	1,690	1,760	1,730
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<20.1	<20.1	<20.1
S97T001918	211:11R	Drainable liquid	<40.1	<40.1	<40.1
S97T001934	211:12	Drainable liquid	<40.1	<40.1	<40.1
S97T001978	213:12R	Drainable liquid	<20.1	<20.1	<20.1

Table B2-80. Tank 241-SY-102 Analytical Results: Boron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	72.1	144	108[QC:e]
S97T001895		Lower half	141	151	146
S97T001929	211:12	Upper half	162	161	162
S97T001924		Lower half	169	117	143[QC:e]
S97T001990	213:13	Upper half	156	177	167
S97T001988		Lower half	40.0	48.8	44.4
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	16.0	15.0	15.5
S97T001918	211:11R	Drainable liquid	<20.1	<20.1	<20.1
S97T001934	211:12	Drainable liquid	36.1	34.9	35.5
S97T001978	213:12R	Drainable liquid	18.5	18.4	18.4

Table B2-81. Tank 241-SY-102 Analytical Results: Cadmium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	248	233	241
S97T001895		Lower half	567	561	564
S97T001929	211:12	Upper half	60.9	61.4	61.1
S97T001924		Lower half	32.2	32.7	32.5
S97T001990	213:13	Upper half	38.6	38.5	38.5
S97T001988		Lower half	151	158	155
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	1.57	1.92	1.75[QC:e]
S97T001918	211:11R	Drainable liquid	11.8	12.8	12.3
S97T001934	211:12	Drainable liquid	17.7	17.9	17.8
S97T001978	213:12R	Drainable liquid	2.97	2.71	2.84

Table B2-82. Tank 241-SY-102 Analytical Results: Calcium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	2,180	2,130	2,160
S97T001895		Lower half	5,390	5,390	5,390
S97T001929	211:12	Upper half	660	652	656
S97T001924		Lower half	548	592	570
S97T001990	213:13	Upper half	620	627	624
S97T001988		Lower half	2,430	2,560	2,500
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<20.1	<20.1	<20.1
S97T001918	211:11R	Drainable liquid	<40.1	<40.1	<40.1
S97T001934	211:12	Drainable liquid	<40.1	<40.1	<40.1
S97T001978	213:12R	Drainable liquid	<20.1	<20.1	<20.1

Table B2-83. Tank 241-SY-102 Analytical Results: Cerium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	38.0	37.2	37.6
S97T001895		Lower half	<40	<40	<40
S97T001929	211:12	Upper half	121	121	121
S97T001924		Lower half	90.4	90.2	90.3
S97T001990	213:13	Upper half	110	112	111
S97T001988		Lower half	53.3	58.2	55.8
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<20.1	<20.1	<20.1
S97T001918	211:11R	Drainable liquid	<40.1	<40.1	<40.1
S97T001934	211:12	Drainable liquid	<40.1	<40.1	<40.1
S97T001978	213:12R	Drainable liquid	<20.1	<20.1	<20.1

Table B2-84. Tank 241-SY-102 Analytical Results: Chromium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	1,140	1,100	1,120
S97T001895		Lower half	1,370	1,270	1,320
S97T001929	211:12	Upper half	20,900	21,000	21,000
S97T001924		Lower half	21,800	22,400	22,100[QC:d]
S97T001990	213:13	Upper half	21,900	22,100	22,000
S97T001988		Lower half	6,880	7,230	7,060[QC:d]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	954	950	952
S97T001918	211:11R	Drainable liquid	804	821	813
S97T001934	211:12	Drainable liquid	648	650	649
S97T001978	213:12R	Drainable liquid	757	758	758

Table B2-85. Tank 241-SY-102 Analytical Results: Cobalt (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	5.31	4.91	5.11
S97T001895		Lower half	9.34	9.39	9.37
S97T001929	211:12	Upper half	10.5	10.2	10.3
S97T001924		Lower half	11.0	10.6	10.8
S97T001990	213:13	Upper half	8.16	8.7	8.43
S97T001988		Lower half	5.51	5.54	5.53
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<4.02	<4.02	<4.02
S97T001918	211:11R	Drainable liquid	<8.02	<8.02	<8.02
S97T001934	211:12	Drainable liquid	<8.02	<8.02	<8.02
S97T001978	213:12R	Drainable liquid	<4.02	<4.02	<4.02

Table B2-86. Tank 241-SY-102 Analytical Results: Copper (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	55.0	55.1	55.0
S97T001895		Lower half	75.7	73.9	74.8
S97T001929	211:12	Upper half	<4	<3.99	<4
S97T001924		Lower half	<3.99	<4	<4
S97T001990	213:13	Upper half	<1.99	<1.99	<1.99
S97T001988		Lower half	22.6	24.2	23.4
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<2.01	<2.01	<2.01
S97T001918	211:11R	Drainable liquid	<4.01	<4.01	<4.01
S97T001934	211:12	Drainable liquid	<4.01	<4.01	<4.01
S97T001978	213:12R	Drainable liquid	<2.01	<2.01	<2.01

Table B2-87. Tank 241-SY-102 Analytical Results: Iron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	13,900	13,200	13,600[QC:c,h]
S97T001895		Lower half	29,700	29,400	29,600
S97T001929	211:12	Upper half	7,360	7,530	7,450
S97T001924		Lower half	5,700	5,770	5,740
S97T001990	213:13	Upper half	6,030	6,020	6,030
S97T001988		Lower half	16,100	18,100	17,100[QC:d]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<10.1	<10.1	<10.1
S97T001918	211:11R	Drainable liquid	<20.1	<20.1	<20.1
S97T001934	211:12	Drainable liquid	<20.1	<20.1	<20.1
S97T001978	213:12R	Drainable liquid	<10.1	<10.1	<10.1

Table B2-88. Tank 241-SY-102 Analytical Results: Lanthanum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	214	205	210
S97T001895		Lower half	47.4	47.3	47.3
S97T001929	211:12	Upper half	71.3	72.1	71.7
S97T001924		Lower half	56.6	57	56.8
S97T001990	213:13	Upper half	57.0	56.7	56.9
S97T001988		Lower half	43.6	45.3	44.5
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	< 10.1	< 10.1	< 10.1
S97T001918	211:11R	Drainable liquid	< 20.1	< 20.1	< 20.1
S97T001934	211:12	Drainable liquid	< 20.1	< 20.1	< 20.1
S97T001978	213:12R	Drainable liquid	< 10.1	< 10.1	< 10.1

Table B2-89. Tank 241-SY-102 Analytical Results: Lead (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	480	446	463
S97T001895		Lower half	2,150	2,100	2,130
S97T001929	211:12	Upper half	667	683	675
S97T001924		Lower half	494	505	500
S97T001990	213:13	Upper half	629	630	630
S97T001988		Lower half	1,630	1,730	1,680
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	< 20.1	< 20.1	< 20.1
S97T001918	211:11R	Drainable liquid	< 40.1	< 40.1	< 40.1
S97T001934	211:12	Drainable liquid	< 40.1	< 40.1	< 40.1
S97T001978	213:12R	Drainable liquid	< 20.1	< 20.1	< 20.1

Table B2-90. Tank 241-SY-102 Analytical Results: Lithium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	12.5	12.2	12.3
S97T001895		Lower half	18.9	18.7	18.8
S97T001929	211:12	Upper half	9.71	9.60	9.66
S97T001924		Lower half	12.8	12.8	12.8
S97T001990	213:13	Upper half	25.5	24.9	25.2
S97T001988		Lower half	19.8	20.5	20.1
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<2.01	<2.01	<2.01
S97T001918	211:11R	Drainable liquid	5.72	5.90	5.81
S97T001934	211:12	Drainable liquid	9.71	9.63	9.67
S97T001978	213:12R	Drainable liquid	15.5	15.6	15.6
S97T001832	HHF	Whole	1,920	1,960	1,940
S97T001873	Field blank	Whole	< 0.01	< 0.01	< 0.01

Table B2-91. Tank 241-SY-102 Analytical Results: Magnesium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	514	492	503
S97T001895		Lower half	1,080	1,080	1,080
S97T001929	211:12	Upper half	325	334	330
S97T001924		Lower half	232	214	223
S97T001990	213:13	Upper half	303	306	305
S97T001988		Lower half	1,010	1,060	1,040
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<20.1	<20.1	<20.1
S97T001918	211:11R	Drainable liquid	<40.1	<40.1	<40.1
S97T001934	211:12	Drainable liquid	<40.1	<40.1	<40.1
S97T001978	213:12R	Drainable liquid	<20.1	<20.1	<20.1

Table B2-92. Tank 241-SY-102 Analytical Results: Manganese (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	3,080	2,910	3,000
S97T001895		Lower half	6,660	6,640	6,650[QC:d]
S97T001929	211:12	Upper half	3,240	3,350	3,300
S97T001924		Lower half	1,990	2,050	2,020
S97T001990	213:13	Upper half	3,110	3,140	3,130
S97T001988		Lower half	8,080	8,600	8,340[QC:d]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<2.01	<2.01	<2.01
S97T001918	211:11R	Drainable liquid	<4.01	<4.01	<4.01
S97T001934	211:12	Drainable liquid	<4.01	<4.01	<4.01
S97T001978	213:12R	Drainable liquid	<2.01	<2.01	<2.01

Table B2-93. Tank 241-SY-102 Analytical Results: Molybdenum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	15.6	15.2	15.4
S97T001895		Lower half	20.0	20.2	20.1
S97T001929	211:12	Upper half	27.1	25.1	26.1
S97T001924		Lower half	28.5	26.8	27.6
S97T001990	213:13	Upper half	24.3	26.5	25.4
S97T001988		Lower half	33.4	33.4	33.4
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	15.0	15.2	15.1
S97T001918	211:11R	Drainable liquid	<20.1	<20.1	<20.1
S97T001934	211:12	Drainable liquid	42.6	42.2	42.4
S97T001978	213:12R	Drainable liquid	20.8	20.9	20.9

Table B2-94. Tank 241-SY-102 Analytical Results: Neodymium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	<20	<20	<20
S97T001895		Lower half	89.4	87.3	88.3
S97T001929	211:12	Upper half	185	188	187
S97T001924		Lower half	153	155	154
S97T001990	213:13	Upper half	148	147	148
S97T001988		Lower half	77.2	81.0	79.1
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<20.1	<20.1	<20.1
S97T001918	211:11R	Drainable liquid	<40.1	<40.1	<40.1
S97T001934	211:12	Drainable liquid	<40.1	<40.1	<40.1
S97T001978	213:12R	Drainable liquid	<20.1	<20.1	<20.1

Table B2-95. Tank 241-SY-102 Analytical Results: Nickel (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	115	109	112
S97T001895		Lower half	279	273	276
S97T001929	211:12	Upper half	207	210	209
S97T001924		Lower half	221	227	224
S97T001990	213:13	Upper half	208	205	207
S97T001988		Lower half	106	116	111
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<4.02	<4.02	<4.02
S97T001918	211:11R	Drainable liquid	<8.02	<8.02	<8.02
S97T001934	211:12	Drainable liquid	<8.02	<8.02	<8.02
S97T001978	213:12R	Drainable liquid	<4.02	<4.02	<4.02

Table B2-96. Tank 241-SY-102 Analytical Results: Phosphorus (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	1,670	1,600	1,640
S97T001895		Lower half	3,050	3,090	3,070
S97T001929	211:12	Upper half	17,500	18,100	17,800[QC:c]
S97T001924		Lower half	21,800	22,800	22,300
S97T001990	213:13	Upper half	7,840	7,870	7,860
S97T001988		Lower half	1,940	1,980	1,960
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	1,220	1,230	1,230
S97T001918	211:11R	Drainable liquid	1,180	1,200	1,190
S97T001934	211:12	Drainable liquid	2,620	2,570	2,600
S97T001978	213:12R	Drainable liquid	1,150	1,150	1,150

Table B2-97. Tank 241-SY-102 Analytical Results: Potassium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	1,860	1,820	1,840
S97T001895		Lower half	1,830	1,890	1,860
S97T001929	211:12	Upper half	1,090	1,030	1,060
S97T001924		Lower half	771	791	781
S97T001990	213:13	Upper half	982	985	984
S97T001988		Lower half	1,760	1,760	1,760
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	2,470	2,480	2,480
S97T001918	211:11R	Drainable liquid	2,440	2,440	2,440
S97T001934	211:12	Drainable liquid	2,340	2,340	2,340
S97T001978	213:12R	Drainable liquid	2,440	2,420	2,430

Table B2-98. Tank 241-SY-102 Analytical Results: Samarium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	<20	<20	<20
S97T001895		Lower half	<40	<40	<40
S97T001929	211:12	Upper half	<40	<39.9	<40
S97T001924		Lower half	<39.9	<40	<40
S97T001990	213:13	Upper half	28.7	29.5	29.1
S97T001988		Lower half	<19.9	<20	<19.9
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<20.1	<20.1	<20.1
S97T001918	211:11R	Drainable liquid	<40.1	<40.1	<40.1
S97T001934	211:12	Drainable liquid	<40.1	<40.1	<40.1
S97T001978	213:12R	Drainable liquid	<20.1	<20.1	<20.1

Table B2-99. Tank 241-SY-102 Analytical Results: Selenium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	<20	21.8	<20.9
S97T001895		Lower half	<40	<40	<40
S97T001929	211:12	Upper half	<40	<39.9	<40
S97T001924		Lower half	<39.9	<40	<40
S97T001990	213:13	Upper half	27.1	29.6	28.4
S97T001988		Lower half	<19.9	<20	<19.9
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<20.1	<20.1	<20.1
S97T001918	211:11R	Drainable liquid	<40.1	<40.1	<40.1
S97T001934	211:12	Drainable liquid	<40.1	<40.1	<40.1
S97T001978	213:12R	Drainable liquid	<20.1	<20.1	<20.1

Table B2-100. Tank 241-SY-102 Analytical Results: Silicon (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	1,780	1,810	1,800[QC:b]
S97T001895		Lower half	1,410	1,410	1,410[QC:b,d]
S97T001929	211:12	Upper half	984	1,020	1,000[QC:b]
S97T001924		Lower half	1,040	889	965[QC:b]
S97T001990	213:13	Upper half	926	1,080	1,000[QC:b]
S97T001988		Lower half	1,220	1,270	1,250[QC:b,d]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	123	123	123
S97T001918	211:11R	Drainable liquid	57.3	57.6	57.5
S97T001934	211:12	Drainable liquid	85.2	87.7	86.5
S97T001978	213:12R	Drainable liquid	72.5	73.1	72.8

Table B2-101. Tank 241-SY-102 Analytical Results: Silver (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	61.0	60.8	60.9[QC:c]
S97T001895		Lower half	105	123	114
S97T001929	211:12	Upper half	50.3	50.5	50.4
S97T001924		Lower half	22.5	22.6	22.6
S97T001990	213:13	Upper half	29.3	29.5	29.4
S97T001988		Lower half	274	290	282[QC:c]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	4.08	3.75	3.92
S97T001918	211:11R	Drainable liquid	4.69	4.09	4.39
S97T001934	211:12	Drainable liquid	7.33	6.97	7.15
S97T001978	213:12R	Drainable liquid	4.02	4.13	4.07

Table B2-102. Tank 241-SY-102 Analytical Results: Sodium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	48,200	47,500	47,900[QC:d,h]
S97T001895		Lower half	54,800	56,400	55,600[QC:d]
S97T001929	211:12	Upper half	103,000	102,000	103,000[QC:c]
S97T001924		Lower half	123,000	122,000	123,000[QC:c]
S97T001990	213:13	Upper half	85,000	84,400	84,700
S97T001988		Lower half	64,500	64,300	64,400[QC:c]
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	54,800	54,500	54,700[QC:d]
S97T001918	211:11R	Drainable liquid	59,900	60,800	60,400[QC:d]
S97T001934	211:12	Drainable liquid	94,500	93,400	94,000[QC:c]
S97T001978	213:12R	Drainable liquid	59,100	59,100	59,100[QC:c]

Table B2-103. Tank 241-SY-102 Analytical Results: Strontium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	58.6	56.1	57.4
S97T001895		Lower half	150	149	150
S97T001929	211:12	Upper half	14.3	14.5	14.4
S97T001924		Lower half	11.4	11.3	11.4
S97T001990	213:13	Upper half	14.5	14.6	14.6
S97T001988		Lower half	94.3	98.6	96.4
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<2.01	<2.01	<2.01
S97T001918	211:11R	Drainable liquid	<4.01	<4.01	<4.01
S97T001934	211:12	Drainable liquid	<4.01	<4.01	<4.01
S97T001978	213:12R	Drainable liquid	<2.01	<2.01	<2.01

Table B2-104. Tank 241-SY-102 Analytical Results: Sulfur (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	771	742	757
S97T001895		Lower half	1,050	1,090	1,070
S97T001929	211:12	Upper half	1,470	1,370	1,420
S97T001924		Lower half	1,680	1,670	1,680
S97T001990	213:13	Upper half	865	862	864
S97T001988		Lower half	1,160	1,160	1,160
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	670	676	673
S97T001918	211:11R	Drainable liquid	861	875	868
S97T001934	211:12	Drainable liquid	2,140	2,120	2,130
S97T001978	213:12R	Drainable liquid	816	824	820

Table B2-105. Tank 241-SY-102 Analytical Results: Thallium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	<40	<40	<40
S97T001895		Lower half	<80	<80	<80
S97T001929	211:12	Upper half	<79.9	<79.7	<79.8
S97T001924		Lower half	<79.9	<80	<80
S97T001990	213:13	Upper half	<39.9	<39.9	<39.9
S97T001988		Lower half	<39.8	<40	<39.9
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<40.2	<40.2	<40.2
S97T001918	211:11R	Drainable liquid	<80.2	<80.2	<80.2
S97T001934	211:12	Drainable liquid	<80.2	<80.2	<80.2
S97T001978	213:12R	Drainable liquid	<40.2	<40.2	<40.2

Table B2-106. Tank 241-SY-102 Analytical Results: Titanium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	15.5	16.6	16.1
S97T001895		Lower half	64.9	66.4	65.7
S97T001929	211:12	Upper half	19.1	19.2	19.1
S97T001924		Lower half	19.9	15.2	17.5[QC:e]
S97T001990	213:13	Upper half	16.9	17.9	17.4
S97T001988		Lower half	47.5	46.1	46.8
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<2.01	<2.01	<2.01
S97T001918	211:11R	Drainable liquid	<4.01	<4.01	<4.01
S97T001934	211:12	Drainable liquid	<4.01	<4.01	<4.01
S97T001978	213:12R	Drainable liquid	<2.01	<2.01	<2.01

Table B2-107. Tank 241-SY-102 Analytical Results: Total Uranium (ICP).[1]

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	548	523	536
S97T001895		Lower half	306	284	295
S97T001929	211:12	Upper half	2,260	2,280	2,270[QC:c]
S97T001924		Lower half	2,270	2,270	2,270[QC:c]
S97T001990	213:13	Upper half	1,870	1,850	1,860
S97T001988		Lower half	431	452	442
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<100	<100	<100
S97T001918	211:11R	Drainable liquid	<200	<200	<200
S97T001934	211:12	Drainable liquid	<200	<200	<200
S97T001978	213:12R	Drainable liquid	<100	<100	<100

Note:

[1]Sample analysis dates (mm/dd/yy): 8/25/97 (S97T001918, S97T001934), 9/2/97 (S97T001973, S97T001978), 9/8/97 (S97T001895, S97T001912, S97T001924, S97T001929), and 9/15/97 (S97T001988, S97T001990).

Table B2-108. Tank 241-SY-102 Analytical Results: Vanadium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	<10	<10	<10
S97T001895		Lower half	<20	<20	<20
S97T001929	211:12	Upper half	<20	<19.9	<19.9
S97T001924		Lower half	<20	<20	<20
S97T001990	213:13	Upper half	<9.97	10.3	<10.1
S97T001988		Lower half	<9.96	<10	<9.98
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<10.1	<10.1	<10.1
S97T001918	211:11R	Drainable liquid	<20.1	<20.1	<20.1
S97T001934	211:12	Drainable liquid	<20.1	<20.1	<20.1
S97T001978	213:12R	Drainable liquid	<10.1	<10.1	<10.1

Table B2-109. Tank 241-SY-102 Analytical Results: Zinc (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	258	230	244
S97T001895		Lower half	744	734	739
S97T001929	211:12	Upper half	269	279	274
S97T001924		Lower half	255	215	235
S97T001990	213:13	Upper half	157	158	158
S97T001988		Lower half	455	481	468
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	4.58	4.45	4.52
S97T001918	211:11R	Drainable liquid	5.57	6.37	5.97
S97T001934	211:12	Drainable liquid	8.82	7.98	8.40
S97T001978	213:12R	Drainable liquid	3.75	3.55	3.65

Table B2-110. Tank 241-SY-102 Analytical Results: Zirconium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	47.2	45.8	46.5
S97T001895		Lower half	64.5	60.7	62.6
S97T001929	211:12	Upper half	76.8	90.8	83.8
S97T001924		Lower half	88.0	98.1	93.0
S97T001990	213:13	Upper half	40.9	41.0	41.0
S97T001988		Lower half	121	127	124
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<2.01	<2.01	<2.01
S97T001918	211:11R	Drainable liquid	<4.01	<4.01	<4.01
S97T001934	211:12	Drainable liquid	<4.01	<4.01	<4.01
S97T001978	213:12R	Drainable liquid	<2.01	<2.01	<2.01

Table B2-111. Tank 241-SY-102 Analytical Results: Bromide (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
S97T001913	211:11R	Upper half	522	<510	<516
S97T001908		Lower half	537	558	547
S97T001930	211:12	Upper half	<1,220	<1,240	<1,230
S97T001925		Lower half	<505	<515	<510
S97T001991	213:13	Upper half	2,380	2,300	2,340
S97T001989		Lower half	2,370	2,390	2,380
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<518	<518	<518
S97T001918	211:11R	Drainable liquid	270	270	270
S97T001934	211:12	Drainable liquid	770	788	779
S97T001978	213:12R	Drainable liquid	551	548	549
S97T001832	HHF	Whole	21,470	21,400	21,440
S97T001873	Field blank	Whole	< 0.125	< 0.125	< 0.125

Table B2-112. Tank 241-SY-102 Analytical Results: Chloride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
S97T001913	211:11R	Upper half	1,580	1,580	1,580
S97T001908		Lower half	1,530	1,510	1,520
S97T001930	211:12	Upper half	1,400	1,300	1,350
S97T001925		Lower half	1,590	1,510	1,550
S97T001991	213:13	Upper half	3,820	4,260	4,040
S97T001989		Lower half	2,880	2,820	2,850
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	1,610	1,610	1,610
S97T001918	211:11R	Drainable liquid	1,650	1,650	1,650
S97T001934	211:12	Drainable liquid	2,460	2,540	2,500
S97T001978	213:12R	Drainable liquid	1,870	1,890	1,880
S97T001873	Field blank	Whole	0.041	0.047	0.044

Table B2-113. Tank 241-SY-102 Analytical Results: Fluoride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
S97T001913	211:11R	Upper half	501	457	479
S97T001908		Lower half	383	379	381
S97T001930	211:12	Upper half	1,650	1,220	1,440[QC:e]
S97T001925		Lower half	3,930	4,210	4,070
S97T001991	213:13	Upper half	829	749	789
S97T001989		Lower half	3,050	2,990	3,020
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	815	706	760
S97T001918	211:11R	Drainable liquid	515	508	512[QC:c]
S97T001934	211:12	Drainable liquid	298	300	299
S97T001978	213:12R	Drainable liquid	560	579	569
S97T001873	Field blank	Whole	< 0.012	< 0.012	< 0.012

Table B2-114. Tank 241-SY-102 Analytical Results: Nitrate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
S97T001913	211:11R	Upper half	54,200	52,900	53,500
S97T001908		Lower half	57,800	57,400	57,600
S97T001930	211:12	Upper half	57,900	55,700	56,800
S97T001925		Lower half	92,700	88,800	90,700
S97T001991	213:13	Upper half	149,000	168,000	158,000
S97T001989		Lower half	135,000	141,000	138,000
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	51,400	52,000	51,700
S97T001918	211:11R	Drainable liquid	61,100	61,700	61,400
S97T001934	211:12	Drainable liquid	114,000	113,000	114,000
S97T001978	213:12R	Drainable liquid	60,900	60,400	60,700
S97T001873	Field blank	Whole	0.25	0.24	0.25

Table B2-115. Tank 241-SY-102 Analytical Results: Nitrite (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
S97T001913	211:11R	Upper half	18,100	17,700	17,900
S97T001908		Lower half	18,700	18,700	18,700
S97T001930	211:12	Upper half	17,900	16,300	17,100
S97T001925		Lower half	21,800	20,800	21,300
S97T001991	213:13	Upper half	51,500	51,200	51,400
S97T001989		Lower half	43,300	42,100	42,700
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	17,000	16,400	16,700
S97T001918	211:11R	Drainable liquid	20,000	20,200	20,100
S97T001934	211:12	Drainable liquid	35,000	35,400	35,200
S97T001978	213:12R	Drainable liquid	20,700	21,100	20,900
S97T001873	Field blank	Whole	< 0.11	< 0.11	< 0.11

Table B2-116. Tank 241-SY-102 Analytical Results: Phosphate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T001913	211:11R	Upper half	3,160	2,440	2,800[QC:e]
S97T001908		Lower half	3,100	2,870	2,980
S97T001930	211:12	Upper half	53,600	40,900	47,200[QC:e]
S97T001925		Lower half	66,600	68,500	67,500
S97T001991	213:13	Upper half	7,780	7,390	7,580
S97T001989		Lower half	54,200	54,300	54,200
Liquids			µg/mL	µg/mL	µg/mL
S97T001973	211:11	Drainable liquid	3,490	3,770	3,630
S97T001918	211:11R	Drainable liquid	3,100	3,410	3,250
S97T001934	211:12	Drainable liquid	7,560	7,640	7,600
S97T001978	213:12R	Drainable liquid	4,660	3,440	4,050[QC:e]
S97T001873	Field blank	Whole	0.24	< 0.12	< 0.18

Table B2-117. Tank 241-SY-102 Analytical Results: Sulfate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			µg/g	µg/g	µg/g
S97T001913	211:11R	Upper half	2,370	2,120	2,240
S97T001908		Lower half	3,260	3,180	3,220
S97T001930	211:12	Upper half	5,600	5,630	5,620
S97T001925		Lower half	4,730	4,670	4,700
S97T001991	213:13	Upper half	8,590	8,760	8,670
S97T001989		Lower half	6,880	6,560	6,720
Liquids			µg/mL	µg/mL	µg/mL
S97T001973	211:11	Drainable liquid	2,150	2,200	2,180
S97T001918	211:11R	Drainable liquid	2,460	3,140	2,800[QC:e]
S97T001934	211:12	Drainable liquid	6,260	6,140	6,200
S97T001978	213:12R	Drainable liquid	2,620	2,930	2,770
S97T001873	Field blank	Whole	< 0.14	< 0.14	< 0.14

Table B2-118. Tank 241-SY-102 Analytical Results: Oxalate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: water digest			**µg/g**	**µg/g**	**µg/g**
S97T001913	211:11R	Upper half	<425	<428	<426
S97T001908		Lower half	<437	<442	<439
S97T001930	211:12	Upper half	17,800	16,700	17,200
S97T001925		Lower half	20,700	20,000	20,300
S97T001991	213:13	Upper half	4,510	4,920	4,720
S97T001989		Lower half	99,900	106,000	103,000
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S97T001973	211:11	Drainable liquid	<435	<435	<435
S97T001918	211:11R	Drainable liquid	<223	<223	<223
S97T001934	211:12	Drainable liquid	992	1,060	1,030
S97T001978	213:12R	Drainable liquid	<435	<435	<435
S97T001873	Field blank	Whole	< 0.11	< 0.11	< 0.11

Table B2-119. Tank 241-SY-102 Analytical Results: Percent Water (DSC/TGA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			**wt%**	**wt%**	**wt%**
S97T001910	211:11R	Upper half	76.6	75.7	76.2
S97T001893		Lower half	67.4	69.2	68.3
S97T001928	211:12	Upper half	52.0	50.8	51.4
S97T001922		Lower half	50.3	51.0	50.7
S97T001985	213:13	Upper half	63.3	63.4	63.3
S97T001983		Lower half	39.6	39.3	39.4
Liquids			**wt%**	**wt%**	**wt%**
S97T001972	211:11	Drainable liquid	84.8	85.1	84.9
S97T001917	211:11R	Drainable liquid	82.9	83.0	82.9
S97T001933	211:12	Drainable liquid	74.1	73.9	74.0
S97T001977	213:12R	Drainable liquid	84.4	83.9	84.2

Table B2-120. Tank 241-SY-102 Analytical Results: Bulk Density.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			**g/mL**	**g/mL**	**g/mL**
S97T001909	211:11R	Upper half	1.22	n/a	1.22
S97T001892		Lower half	1.25	n/a	1.25
S97T001921	211:12	Lower half	1.64	n/a	1.64
S97T001981	213:13	Lower half	1.64	n/a	1.64

Table B2-121. Tank 241-SY-102 Analytical Results: Specific Gravity.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**unitless**	**unitless**	**unitless**
S97T001972	211:11	Drainable liquid	1.12	1.12	1.12
S97T001917	211:11R	Drainable liquid	1.12	1.10	1.11
S97T001933	211:12	Drainable liquid	1.20	1.22	1.21
S97T001977	213:12R	Drainable liquid	1.17	1.14	1.15

Table B2-122. Tank 241-SY-102 Analytical Results: Total Alpha (Alpha Rad).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			**µCi/g**	**µCi/g**	**µCi/g**
S97T001996	211:11R	Upper half	18.7	17.8	18.3
S97T001995		Lower half	92.9	89.1	91.0
S97T001998	211:12	Lower half	1.84	1.59	1.72
S97T001987	213:13	Lower half	2.72	2.60	2.66
Liquids			**µCi/mL**	**µCi/mL**	**µCi/mL**
S97T001972	211:11	Drainable liquid	0.0405	<0.0488	<0.0447[QC:c]
S97T001917	211:11R	Drainable liquid	0.00146	0.00270	0.00208[QC:e,f]
S97T001933	211:12	Drainable liquid	0.00535	0.00506	0.00521[QC:f]
S97T001977	213:12R	Drainable liquid	0.0805	<0.0559	<0.0682[QC:e]
S97T001873	Field blank	Whole	<5.48E-07	<6.21E-07	< 5.85E-07

Table B2-123. Tank 241-SY-102 ytical Results: Plutonium-239/240.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			**µCi/g**	**µCi/g**	**µCi/g**
S97T001996	211:11R	Upper half	5.99	5.74	5.87
S97T001995		Lower half	27.5	26.1	26.8
S97T001998	211:12	Lower half	0.286	0.280	0.283
S97T001987	213:13	Lower half	0.467	0.471	0.469

Table B2-124. Tank 241-SY-102 Analytical Results: Americium-241 (AEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: fusion			**µCi/g**	**µCi/g**	**µCi/g**
S97T001996	211:11R	Upper half	16.5	16.3	16.4
S97T001995		Lower half	94.2	105	99.6
S97T001998	211:12	Lower half	1.53	1.66	1.60
S97T001987	211:12	Lower half	2.08	1.93	2.00

Note:

AEA = alpha energy analysis

Table B2-125. Tank 241-SY-102 Analytical Results: Thorium-229 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	<0.0162	<0.0162	<0.0162
S97T001895		Lower half	0.0549	0.0578	0.0563
S97T001929	211:12	Upper half	<0.078	<0.0778	<0.0779
S97T001924		Lower half	<0.0779	<0.078	<0.078
S97T001990	213:13	Upper half	<0.142	<0.142	<0.142
S97T001988		Lower half	0.129	0.125	0.127

Table B2-126. Tank 241-SY-102 Analytical Results: Thorium-230 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	<0.0244	<0.0244	<0.0244
S97T001895		Lower half	0.524	0.496	0.510
S97T001929	211:12	Upper half	<0.117	<0.117	<0.117
S97T001924		Lower half	<0.117	<0.117	<0.117
S97T001990	213:13	Upper half	0.146	0.166	0.156
S97T001988		Lower half	1.19	1.23	1.21

Table B2-127. Tank 241-SY-102 Analytical Results: Thorium-232 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	204	174	189[QC:d]
S97T001895		Lower half	<0.0979	<0.0979	<0.0979[QC:d]
S97T001929	211:12	Upper half	743	850	797
S97T001924		Lower half	222	224	223
S97T001990	213:13	Upper half	1,330	1,330	1,330
S97T001988		Lower half	<0.0247	<0.0248	<0.0248[QC:d]

Table B2-128. Tank 241-SY-102 Analytical Results: Uranium-233 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	<0.191	<0.191	<0.191
S97T001895		Lower half	1.10	0.961	1.03
S97T001929	211:12	Upper half	0.482	0.477	0.480
S97T001924		Lower half	0.339	0.317	0.328
S97T001990	213:13	Upper half	0.549	0.581	0.565
S97T001988		Lower half	2.05	2.18	2.11

Table B2-129. Tank 241-SY-102 Analytical Results: Uranium-234 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	<0.261	<0.261	<0.261
S97T001895		Lower half	0.0727	0.0734	0.0731
S97T001929	211:12	Upper half	<0.261	<0.26	<0.26
S97T001924		Lower half	<0.261	<0.261	<0.261
S97T001990	213:13	Upper half	<0.324	<0.324	<0.324
S97T001988		Lower half	<0.0929	<0.0933	<0.0931

Table B2-130. Tank 241-SY-102 Analytical Results: Uranium-235 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	5.10	5.07	5.08
S97T001895		Lower half	2.43	2.28	2.35
S97T001929	211:12	Upper half	16.8	16.4	16.6
S97T001924		Lower half	17.0	16.8	16.9
S97T001990	213:13	Upper half	14.8	14.7	14.8
S97T001988		Lower half	3.69	3.95	3.82

Table B2-131. Tank 241-SY-102 Analytical Results: Uranium-236 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	0.353	0.349	0.351
S97T001895		Lower half	0.158	0.143	0.150
S97T001929	211:12	Upper half	0.693	0.711	0.702
S97T001924		Lower half	0.699	0.685	0.692
S97T001990	213:13	Upper half	0.604	0.612	0.608
S97T001988		Lower half	0.178	0.191	0.185

Table B2-132. Tank 241-SY-102 Analytical Results: Uranium-238 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	630	607	619
S97T001895		Lower half	263	236	249
S97T001929	211:12	Upper half	2,470	2,420	2,450
S97T001924		Lower half	2,490	2,510	2,500
S97T001990	213:13	Upper half	2,130	2,160	2,150
S97T001988		Lower half	470	501	485

Table B2-133. Tank 241-SY-102 Analytical Results: Neptunium-237 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	0.649	0.692	0.670
S97T001895		Lower half	3.51	3.49	3.50
S97T001929	211:12	Upper half	1.17	1.45	1.31[QC:e]
S97T001924		Lower half	1.21	1.35	1.28
S97T001990	213:13	Upper half	0.603	0.726	0.665
S97T001988		Lower half	1.75	1.85	1.80

Table B2-134. Tank 241-SY-102 Analytical Results: Plutonium-239 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			**µg/g**	**µg/g**	**µg/g**
S97T001912	211:11R	Upper half	90.6	90.2	90.4[QC:d]
S97T001895		Lower half	245	244	244
S97T001929	211:12	Upper half	5.16	5.06	5.11
S97T001924		Lower half	4.00	3.89	3.94
S97T001990	213:13	Upper half	6.10	6.00	6.05
S97T001988		Lower half	64.6	66.2	65.4

Table B2-135. Tank 241-SY-102 Analytical Results: Plutonium-240 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	7.28	7.25	7.27
S97T001895		Lower half	27.4	27.4	27.4
S97T001929	211:12	Upper half	0.461	0.458	0.459
S97T001924		Lower half	0.324	0.316	0.320
S97T001990	213:13	Upper half	0.543	0.515	0.529
S97T001988		Lower half	7.29	7.41	7.35

Table B2-136. Tank 241-SY-102 Analytical Results: Plutonium-242 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	0.0906	0.0963	0.0934
S97T001895		Lower half	0.480	0.475	0.477
S97T001929	211:12	Upper half	<0.136	<0.135	<0.135
S97T001924		Lower half	<0.136	<0.136	<0.136
S97T001990	213:13	Upper half	<0.0895	<0.0894	<0.0895
S97T001988		Lower half	0.122	0.128	0.125

Table B2-137. Tank 241-SY-102 Analytical Results: Plutonium-241/Americium-241 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	5.42	5.34	5.38
S97T001895		Lower half	26.1	26.3	26.2
S97T001929	211:12	Upper half	0.717	0.750	0.733
S97T001924		Lower half	0.545	0.537	0.541
S97T001990	213:13	Upper half	0.717	0.692	0.705
S97T001988		Lower half	5.66	5.80	5.73

Table B2-138. Tank 241-SY-102 Analytical Results: Americium-243/Curium-243 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	<0.0276	<0.0276	<0.0276
S97T001895		Lower half	<0.0289	<0.0289	<0.0289
S97T001929	211:12	Upper half	<0.133	<0.132	<0.132
S97T001924		Lower half	<0.133	<0.133	<0.133
S97T001990	213:13	Upper half	<0.157	<0.157	<0.157
S97T001988		Lower half	<0.0326	<0.0328	<0.0327

Table B2-139. Tank 241-SY-102 Analytical Results: Plutonium-244/Curium-244 (ICP/MS).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T001912	211:11R	Upper half	<0.0149	<0.0149	<0.0149
S97T001895		Lower half	<0.0156	<0.0156	<0.0156
S97T001929	211:12	Upper half	<0.0714	<0.0712	<0.0713
S97T001924		Lower half	<0.0713	<0.0714	<0.0714
S97T001990	213:13	Upper half	<0.0844	<0.0844	<0.0844
S97T001988		Lower half	<0.0175	<0.0176	<0.0176

Table B2-140. Tank 241-SY-102 Analytical Results: Ammonia (Ion Selective Electrode [NH_3]).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**$\mu g\ NH_3/mL$**	**$\mu g\ NH_3/mL$**	**$\mu g\ NH_3/mL$**
S97T001973	211:11	Drainable liquid	90.4	83.4	86.9
S97T001975		Drainable liquid	75.4	45.4	60.4[QC:e]
S97T001918	211:11R	Drainable liquid	32.7	39	35.9
S97T001919		Drainable liquid	< 12.5	< 12.5	< 12.5
S97T001934	211:12	Drainable liquid	< 10	< 10	< 10
S97T001978	213:12R	Drainable liquid	114	117	116
S97T001979		Drainable liquid	88.0	32.6	60.3[QC:e]
S97T001873	Field blank	Whole	0.20	< 5.0	< 2.6

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Table B2-141. Tank 241-SY-102 Analytical Results: Aluminum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S95T003139	Riser 1A	Grab sample	553	557	555
S95T003140		Grab sample	1,010	1,000	1,010

Table B2-142. Tank 241-SY-102 Analytical Results: Iron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S95T003139	Riser 1A	Grab sample	< 5.05	< 5.05	< 5.05
S95T003140		Grab sample	< 5.05	< 5.05	< 5.05

Table B2-143. Tank 241-SY-102 Analytical Results: Sodium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S95T003139	Riser 1A	Grab sample	16,700	16,800	16,700
S95T003140		Grab sample	30,200	30,000	30,100

Table B2-144. Tank 241-SY-102 Analytical Results: Chloride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S95T003139	Riser 1A	Grab sample	197	192	195
S95T003140		Grab sample	742	747	745

Table B2-145. Tank 241-SY-102 Analytical Results: Fluoride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S95T003139	Riser 1A	Grab sample	548	548	548
S95T003140		Grab sample	707	708	707

Table B2-146. Tank 241-SY-102 Analytical Results: Nitrate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S95T003139	Riser 1A	Grab sample	17,900	17,800	17,900
S95T003140		Grab sample	32,700	33,100	32,900

Table B2-147. Tank 241-SY-102 Analytical Results: Nitrite (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S95T003139	Riser 1A	Grab sample	3,120	3,030	3,080
S95T003140		Grab sample	9,640	9,780	9,710

Table B2-148. Tank 241-SY-102 Analytical Results: Phosphate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S95T003139	Riser 1A	Grab sample	682	686	684
S95T003140		Grab sample	904	909	907

Table B2-149. Tank 241-SY-102 Analytical Results: Sulfate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S95T003139	Riser 1A	Grab sample	601	623	612
S95T003140		Grab sample	1,020	1,040	1,030

Table B2-150. Tank 241-SY-102 Analytical Results: Percent Water (DSC/TGA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			%	%	%
S95T003139	Riser 1A	Grab sample	94.7	93.9	94.3
S95T003140		Grab sample	89.2	89.6	89.4

Table B2-151. Tank 241-SY-102 Analytical Results: pH Measurement.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			unitless	unitless	unitless
S95T003139	Riser 1A	Grab sample	12.9	12.9	12.9
S95T003140		Grab sample	13	13.1	13.1

Table B2-152. Tank 241-SY-102 Analytical Results: Specific Gravity.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			unitless	unitless	unitless
S95T003139	Riser 1A	Grab sample	1.02	1.03	1.02
S95T003140		Grab sample	1.05	1.06	1.06

Table B2-153. Tank 241-SY-102 Analytical Results: Cobalt-60 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
S95T003142	Riser 1A	Grab sample	<2.35E-04	<2.74E-04	<2.55E-04
S95T003143		Grab sample	<6.92E-04	<7.18E-04	<7.05E-04

Table B2-154. Tank 241-SY-102 Analytical Results: Strontium-89/90.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
S95T003142	Riser 1A	Grab sample	9.73E-05	9.57E-05	9.65E-05
S95T003143		Grab sample	2.96E-04	3.01E-04	2.99E-04

Table B2-155. Tank 241-SY-102 Analytical Results: Cesium-137 (GEA).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
S95T003142	Riser 1A	Grab sample	6.86	6.93	6.89
S95T003143		Grab sample	21.6	21.6	21.6

Table B2-156. Tank 241-SY-102 Analytical Results: Plutonium-239/240 (Alpha Spectroscopy).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
S95T003142	Riser 1A	Grab sample	3.30E-05	2.80E-05	3.05E-05
S95T003143		Grab sample	1.20E-04	1.16E-04	1.18E-04

Table B2-157. Tank 241-SY-102 Analytical Results: Americium-241.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
S95T003142	Riser 1A	Grab sample	<3.15E-05	<3.61E-05	<3.38E-05
S95T003143		Grab sample	<2.72E-05	<3.02E-05	<2.87E-05

Table B2-158. Tank 241-SY-102 Analytical Results: Total Organic Carbon (Furnace Oxidation).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg C/mL	µg C/mL	µg C/mL
S95T003139	Riser 1A	Grab sample	1,000	853	927
S95T003140		Grab sample	1,460	1,440	1,450

Table B2-159. Tank 241-SY-102 Analytical Results: Total Inorganic Carbon.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg C/mL	µg C/mL	µg C/mL
S95T003139	Riser 1A	Grab sample	1,410	1,440	1,430
S95T003140		Grab sample	1,650	1,580	1,620

Table B2-160. Tank 241-SY-102 Analytical Results: Ammonia (Ion Selective Electrode [NH_3]).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg NH_3/mL	µg NH_3/mL	µg NH_3/mL
S95T003140	Riser 1A	Grab sample	11.8	10.0	10.9
S95T003142		Grab sample	<5.00	5.62	<5.31

Table B2-161. Tank 241-SY-102 Analytical Results: Hydroxide (OH Direct).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			**µg/mL**	**µg/mL**	**µg/mL**
S95T003139	Riser 1A	Grab sample	2,710	2,660	2,690
S95T003140		Grab sample	5,640	5,680	5,660

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Table B2-162. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Densities for Core 17 Segments.

Segment Number[1]	Density (g/mL)	
	Drainable liquid	Extruded Solids
1	1.03	n/a
2	1.03	n/a
3R	1.08	1.35
4	1.26	1.55

Notes:

[1]Tingey and Sasaki (1995) identify the core 17 segments as 1, 2, 3R, and 4; the chain of custody forms identify these same segments as 5, 6, 7R, and 8, respectively.

Table B2-163. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Centrifuged Sludge Solid Fraction—ICP Metals.[1] (4 sheets)

Analyte	Sample Number	Sample ID[2] (Core:Segment)	Result[3,4] (µg/g)	
			Na_2O_2/Zr	KOH/Ni
Aluminum	90-6010	17:3/4 comp	55,900	50,900
	90-5032	16:comp	36,600	39,100
Antimony	90-6010	17:3/4 comp	<380	<360
	90-5032	16:comp	<330	<270
Arsenic	90-6010	17:3/4 comp	<900	<860
	90-5032	16:comp	<780	<650
Barium	90-6010	17:3/4 comp	201[QC:f]	174[QC:f]
	90-5032	16:comp	113[QC:f]	76[QC:f]
Beryllium	90-6010	17:3/4 comp	11.0	9.00
	90-5032	16:comp	5.00	3.00
Boron	90-6010	17:3/4 comp	<330	<320
	90-5032	16:comp	<290	<240
Cadmium	90-6010	17:3/4 comp	1,180	1,100
	90-5032	16:comp	345	341

Table B2-163. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Centrifuged Sludge Solid Fraction—ICP Metals.[1] (4 sheets)

Analyte	Sample Number	Sample ID[2] (Core:Segment)	Result[3,4] (µg/g)	
			Na_2O_2/Zr	KOH/Ni
Calcium	90-6010	17:3/4 comp	18,100[QC:f]	13,400[QC:f]
	90-5032	16:comp	8,000[QC:f]	6,550[QC:f]
Cerium	90-6010	17:3/4 comp	<950	<910
	90-5032	16:comp	<820	<690
Chromium	90-6010	17:3/4 comp	19,100	17,700[QC:f]
	90-5032	16:comp	19,200	19,400[QC:f]
Cobalt	90-6010	17:3/4 comp	< 1,860	<1,770
	90-5032	16:comp	<1,610	<1,340
Copper	90-6010	17:3/4 comp	277	607
	90-5032	16:comp	126	700
Dysprosium	90-6010	17:3/4 comp	<41	<40
	90-5032	16:comp	<36	<30
Iron	90-6010	17:3/4 comp	64,400[QC:f]	57,900[QC:f]
	90-5032	16:comp	20,600[QC:f]	20,700[QC:f]
Lanthanum	90-6010	17:3/4 comp	173	103
	90-5032	16:comp	128	78
Lead	90-6010	17:3/4 comp	5,000	4,200
	90-5032	16:comp	1,700	1,470
Lithium	90-6010	17:3/4 comp	<55	<53
	90-5032	16:comp	<48	<40
Magnesium	90-6010	17:3/4 comp	3,220[QC:f]	2,700[QC:f]
	90-5032	16:comp	1,000[QC:f]	1,000[QC:f]
Manganese	90-6010	17:3/4 comp	17,300[QC:f]	15,700[QC:f]
	90-5032	16:comp	5,300[QC:f]	5,480[QC:f]
Molybdenum	90-6010	17:3/4 comp	<81	<77
	90-5032	16:comp	73	<58
Neodymium	90-6010	17:3/4 comp	407	<230
	90-5032	16:comp	406	<180
Nickel	90-6010	17:3/4 comp	1,110[QC:f]	n/r
	90-5032	16:comp	943[QC:f]	n/r

Table B2-163. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Centrifuged Sludge Solid Fraction—ICP Metals.[1] (4 sheets)

Analyte	Sample Number	Sample ID[2] (Core:Segment)	Result[3,4] (µg/g)	
			Na_2O_2/Zr	KOH/Ni
Phosphorus	90-6010	17:3/4 comp	n/r	13,600
	90-5032	16:comp	n/r	43,600
Potassium	90-6010	17:3/4 comp	3,480	n/r
	90-5032	16:comp	3,200	n/r
Rhenium	90-6010	17:3/4 comp	<79	<75
	90-5032	16:comp	<68	<57
Rhodium	90-6010	17:3/4 comp	<360	<340
	90-5032	16:comp	438	<260
Ruthenium	90-6010	17:3/4 comp	<290	<270
	90-5032	16:comp	<250	<210
Selenium	90-6010	17:3/4 comp	<860	<880
	90-5032	16:comp	<750	<620
Silicon	90-6010	17:3/4 comp	22,300	17,600
	90-5032	16:comp	7,200	7,300
Silver	90-6010	17:3/4 comp	627	496
	90-5032	16:comp	185	129
Sodium	90-6010	17:3/4 comp	n/r	1.13E+05
	90-5032	16:comp	n/r	1.66E+05
Strontium	90-6010	17:3/4 comp	372[QC:f]	296[QC:f]
	90-5032	16:comp	135[QC:f]	81[QC:f]
Tellurium	90-6010	17:3/4 comp	<390	<370
	90-5032	16:comp	<340	<280
Thallium	90-6010	17:3/4 comp	<7,690	<7,330
	90-5032	16:comp	<6,640	<5,540
Thorium	90-6010	17:3/4 comp	11,400	10,000
	90-5032	16:comp	1,900	2,100
Titanium	90-6010	17:3/4 comp	546	500
	90-5032	16:comp	182	178
Uranium	90-6010	17:3/4 comp	<5,160	<4,920
	90-5032	16:comp	7,780	<3,730

Table B2-163. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Centrifuged Sludge Solid Fraction—ICP Metals.[1] (4 sheets)

Analyte	Sample Number	Sample ID[2] (Core:Segment)	Result[3,4] (μg/g)	
			Na_2O_2/Zr	KOH/Ni
Vanadium	90-6010	17:3/4 comp	< 59	< 56
	90-5032	16:comp	97.0	46.0
Zinc	90-6010	17:3/4 comp	1,640[QC:f]	524[QC:f]
	90-5032	16:comp	1,600[QC:f]	833[QC:f]
Zirconium	90-6010	17:3/4 comp	n/r	1,190
	90-5032	16:comp	n/r	296

Notes:

[1]Tingey and Sasaki (1995)

[2]Sample 17:3/4 comp = core 17, composite of segments 3 and 4; 16:comp = core 16 composite sample.

[3]Na_2O_2/Zr = sodium peroxide flux/zirconium crucible fusion; KOH/Ni = potassium hydroxide flux/nickel crucible fusion.

[4]Laboratory method blanks were prepared with the samples; results for analytes with amounts in the method blank above the detection limit are flagged "QC:f."

Table B2-164. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Centrifuged Sludge Liquid Fraction—ICP Metals.[1] (3 sheets)

Analyte	Sample Number	Sample ID[2] (Core:Segment)	Result (μg/mL)	
			Sample	10X Dilution[3]
Aluminum	90-6011	17:3/4 comp	3,660	3,570
	90-5033	16:comp	2,900	2,850
Antimony	90-6011	17:3/4 comp	<1.2	<11.7
	90-5033	16:comp	< 0.9	< 8.6
Arsenic	90-6011	17:3/4 comp	9.3	11.7
	90-5033	16:comp	5.8	<21
Barium	90-6011	17:3/4 comp	3.9	4.1
	90-5033	16:comp	1.0	1.2
Beryllium	90-6011	17:3/4 comp	0.1	0.1
	90-5033	16:comp	0.08	0.1
Boron	90-6011	17:3/4 comp	24.0	25.2
	90-5033	16:comp	20.5	18.4
Cadmium	90-6011	17:3/4 comp	52.1	55.8
	90-5033	16:comp	24.3	25.8
Calcium	90-6011	17:3/4 comp	27.0	30.0
	90-5033	16:comp	30.0	34.1
Cerium	90-6011	17:3/4 comp	< 2.4	<24
	90-5033	16:comp	< 2.2	<22
Chromium	90-6011	17:3/4 comp	665	691
	90-5033	16:comp	1,120	1,160
Cobalt	90-6011	17:3/4 comp	6.0	<46
	90-5033	16:comp	< 4.3	<43
Copper	90-6011	17:3/4 comp	1.8	2.9
	90-5033	16:comp	3.4	3.8
Dysprosium	90-6011	17:3/4 comp	<0.2	<1.5
	90-5033	16:comp	< 0.1	< 0.9
Iron	90-6011	17:3/4 comp	4.9	5.1
	90-5033	16:comp	7.3	8.0
Lanthanum	90-6011	17:3/4 comp	< 0.2	<2.1
	90-5033	16:comp	< 0.2	<2.2

Table B2-164. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Centrifuged Sludge Liquid Fraction—ICP Metals.[1] (3 sheets)

Analyte	Sample Number	Sample ID[2] (Core:Segment)	Result (μg/mL)	
			Sample	10X Dilution[3]
Lead	90-6011	17:3/4 comp	4.2	<7.4
	90-5033	16:comp	4.6	<10.4
Lithium	90-6011	17:3/4 comp	<0.1	<1.2
	90-5033	16:comp	< 0.1	<1.3
Magnesium	90-6011	17:3/4 comp	0.6	0.8
	90-5033	16:comp	0.7	1.3
Manganese	90-6011	17:3/4 comp	0.2	0.3
	90-5033	16:comp	0.76	0.84
Molybdenum	90-6011	17:3/4 comp	29.7	29.5
	90-5033	16:comp	27.4	28.8
Neodymium	90-6011	17:3/4 comp	< 1.0	<10
	90-5033	16:comp	< 0.6	<5.5
Nickel	90-6011	17:3/4 comp	8.8	9.1
	90-5033	16:comp	10.1	11.8
Phosphorus	90-6011	17:3/4 comp	1,860	1,780
	90-5033	16:comp	3,390	3,340
Potassium	90-6011	17:3/4 comp	2,760	2,750
	90-5033	16:comp	2,480	2,500
Rhenium	90-6011	17:3/4 comp	0.4	<1.7
	90-5033	16:comp	0.5	1.9
Rhodium	90-6011	17:3/4 comp	3.4	<13
	90-5033	16:comp	2.4	<8.2
Ruthenium	90-6011	17:3/4 comp	4.8	<7.8
	90-5033	16:comp	4.8	<6.6
Selenium	90-6011	17:3/4 comp	<1.2	<12
	90-5033	16:comp	< 2.0	<20
Silicon	90-6011	17:3/4 comp	257	247
	90-5033	16:comp	83.8	<93
Silver	90-6011	17:3/4 comp	0.2	<1.7
	90-5033	16:comp	0.4	<2.5

Table B2-164. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Centrifuged Sludge Liquid Fraction—ICP Metals.[1] (3 sheets)

Analyte	Sample Number	Sample ID[2] (Core:Segment)	Result (µg/mL)	
			Sample	10X Dilution[3]
Sodium	90-6011	17:3/4 comp	n/r	1.01E+05
	90-5033	16:comp	1.09E+05	1.20E+05
Strontium	90-6011	17:3/4 comp	0.2	0.2
	90-5033	16:comp	0.26	0.3
Tellurium	90-6011	17:3/4 comp	3.4	<7.1
	90-5033	16:comp	< 0.9	<8.9
Thallium	90-6011	17:3/4 comp	<34	<340
	90-5033	16:comp	< 18	<176
Thorium	90-6011	17:3/4 comp	< 1.8	<18
	90-5033	16:comp	< 1.6	<16
Titanium	90-6011	17:3/4 comp	< 0.1	<1.3
	90-5033	16:comp	< 0.15	<1.5
Uranium	90-6011	17:3/4 comp	18.0	<146
	90-5033	16:comp	17.6	<118
Vanadium	90-6011	17:3/4 comp	0.6	<1.2
	90-5033	16:comp	0.71	1.4
Zinc	90-6011	17:3/4 comp	3.2	5.2
	90-5033	16:comp	1.73	2.1
Zirconium	90-6011	17:3/4 comp	0.1	<1.1
	90-5033	16:comp	0.3	<1.5

Notes:

[1]Tingey and Sasaki (1995)

[2]Sample 17:3/4 comp = core 17, composite of segments 3 and 4; 16:composite = core 16 composite sample.

[3]Results shown in the "10X Dilution" column have been corrected for the dilution.

Table B2-165. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Ion Chromatography Analytes.[1] (2 sheets)

Analyte	Sample Number	Sample ID[2] (Core:Segment)	Result[3]
Centrifuged Sludge Solid Fraction			**µg/g**
Fluoride	90-6010	17:3/4 comp	1,160[QC:f]
	90-5032	16:comp	5,200
Chloride	90-6010	17:3/4 comp	1,840[QC:f]
	90-5032	16:comp	780
Nitrate	90-6010	17:3/4 comp	75,600
	90-5032	16:comp	53,000
Nitrite	90-6010	17:3/4 comp	20,600
	90-5032	16:comp	8,200
Phosphate	90-6010	17:3/4 comp	12,500
	90-5032	16:comp	55,400
Sulfate	90-6010	17:3/4 comp	5,400[QC:f]
	90-5032	16:comp	3,220
Centrifuged Sludge Liquid Fraction			**µg/mL**
Bromide	90-6011	17:3/4 comp	<4
	90-5033	16:comp	n/r
Fluoride	90-6011	17:3/4 comp	440
	90-5033	16:comp	1,600
Chloride	90-6011	17:3/4 comp	3,000
	90-5033	16:comp	1,700
Nitrate	90-6011	17:3/4 comp	1.12E+05
	90-5033	16:comp	1.43E+05
Nitrite	90-6011	17:3/4 comp	27,700
	90-5033	16:comp	21,000
Phosphate	90-6011	17:3/4 comp	5,600
	90-5033	16:comp	8,400

Table B2-165. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Ion Chromatography Analytes.[1] (2 sheets)

Analyte	Sample Number	Sample ID[2] (Core:Segment)	Result[3]
Centrifuged Sludge Liquid Fraction (Cont'd)			**µg/mL**
Sulfate	90-6011	17:3/4 comp	7,400
	90-5033	16:comp	8,000

Notes:

[1]Tingey and Sasaki (1995)

[2]Sample 17:3/4 comp = core 17, composite of segments 3 and 4; 16:comp = core 16 composite sample.

[3]Laboratory method blanks were prepared with the samples; results for analytes with amounts in the method blank above the detection limit are flagged "QC:f".

Table B2-166. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Miscellaneous Analytes.[1]

Analyte	Sample Number	Sample ID[2]	Result	Duplicate	Mean	Units
Centrifuged Sludge Solid Fraction						
Chromium (VI)	90-5032	16:comp	873	n/r	873	μg/g
Total inorganic carbon	90-6010	17:3/4 comp	5,920	6,690	6,310	μg C/g
			7,300	7,200	7,300	μg C/g
	90-5032	16:comp	5,100	6,190	5,650	μg C/g
Total organic carbon	90-5032	16:comp	6,840	7,310	7,080	μg C/g
Centrifuged Sludge Liquid Fraction						
Ammonia Nitrogen	90-5033	16:comp	172	n/r	172	μg N/mL
Chromium (VI)	90-5033	16:comp	1,010	n/r	1,010	μg/mL
Total inorganic carbon	90-6011	17:3/4 comp	5,220	5,290	5,260	μg C/mL
			7,590	7,520	7,560	μg C/mL
	90-5033	16:comp	5,930	6,430	6,180	μg C/mL
Total organic carbon	90-6011	17:3/4 comp	2,490	2,340	2,420	μg C/mL
	90-5033	16:comp	1,570	1,550	1,560	μg C/mL

Notes:

[1]Tingey and Sasaki (1995)

[2]Sample 17:3/4 comp = core 17, composite of segments 3 and 4; 16:comp = core 16 composite sample.

Table B2-167. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Radionuclides.[1] (3 sheets)

Analyte[2]	Sample Number	Sample ID[3] (Core:Seg.)	Result	Duplicate	Mean
Centrifuged Sludge Solid Fraction			µCi/g	µCi/g	µCi/g
Total alpha activity	90-5032	16:comp	31.9	n/r	31.9
Total beta activity	90-5032	16:comp	355	n/r	355
Tritium	90-5032	16:comp	0.00114[QC:f]	n/r	0.00114[QC:f]
Carbon-14	90-5032	16:comp	0.0030	0.0024	0.0027
Cobalt-60	90-6010	17:3/4 comp	0.305	n/r	0.305
	90-5032	16:comp	0.311	n/r	0.311
Selenium-79	90-5032	16:comp	< 0.022	n/r	<0.022
Strontium-90	90-5032	16:comp	136	n/r	136
Niobium-94	90-5032	16:comp	< 0.00141	n/r	<0.00141
Technetium-99	90-5032	16:comp	0.0635	n/r	0.0635
Ruthenium-106	90-6010	17:3/4 comp	< 3.98	n/r	<3.98
	90-5032	16:comp	< 2.55	n/r	<2.55
Tin-113	90-6010	17:3/4 comp	< 5.25	n/r	<5.25
	90-5032	16:comp	< 2.81	n/r	<2.81
Antimony-125	90-6010	17:3/4 comp	< 1.84	n/r	<1.84
	90-5032	16:comp	< 1.08	n/r	<1.08
Cesium-134	90-6010	17:3/4 comp	< 0.399	n/r	<0.399
	90-5032	16:comp	< 0.247	n/r	<0.247
Cesium-137	90-6010	17:3/4 comp	112	n/r	112
	90-5032	16:comp	40.4	n/r	40.4
Cerium-144	90-6010	17:3/4 comp	4.76	n/r	4.76
	90-5032	16:comp	< 2.41	n/r	<2.41
Europium-152	90-6010	17:3/4 comp	< 0.602	n/r	<0.602
	90-5032	16:comp	< 0.357	n/r	<0.357
Europium-154	90-6010	17:3/4 comp	2.72	n/r	2.72
	90-5032	16:comp	2.30	n/r	2.30

Table B2-167. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Radionuclides.[1] (3 sheets)

Analyte[2]	Sample Number	Sample ID[3] (Core:Seg.)	Result	Duplicate	Mean
Centrifuged Sludge Solid Fraction (Cont'd)			**µCi/g**	**µCi/g**	**µCi/g**
Europium-155	90-6010	17:3/4 comp	3.10	n/r	3.10
	90-5032	16:comp	2.40	n/r	2.40
Gadolinium-153	90-6010	17:3/4 comp	< 1.53	n/r	<1.53
	90-5032	16:comp	< 1.01	n/r	<1.01
Neptunium-237	90-5032	16:comp	< 0.0025	n/r	<0.0025
Uranium total (µg/g)	90-5032	16:comp	2,490[QC:f]	n/r	2,490[QC:f]
Plutonium-238	90-5032	16:comp	1.14	n/r	1.14
Plutonium-239/240	90-5032	16:comp	10.1	n/r	10.1
Americium-241	90-6010	17:3/4 comp	126	n/r	126
	90-5032	16:comp	35.6[QC:f]	n/r	35.6[QC:f]
Curium-243/244	90-5032	16:comp	0.0950[QC:f]	n/r	0.0950[QC:f]
Centrifuged Sludge Liquid Fraction			**µCi/mL**	**µCi/mL**	**µCi/mL**
Total alpha activity	90-5033	16:comp	0.00302	n/r	0.00302
Total beta activity	90-5033	16:comp	55.4	n/r	55.4
Tritium	90-5033	16:comp	8.87E-05	n/r	8.87E-05
Carbon-14	90-5033	16:comp	0.0046	0.0052	0.0049
Cobalt-60	90-6011	17:3/4 comp	0.00947	n/r	0.00947
	90-5033	16:comp	7.81E-04	n/r	7.81E-04
Selenium-79	90-5033	16:comp	1.59E-04	n/r	1.59E-04
Strontium-90	90-5033	16:comp	2.89	n/r	2.89
Technetium-99	90-5033	16:comp	0.0635	n/r	0.0635
Ruthenium-106	90-6011	17:3/4 comp	< 0.260	n/r	<0.260
Tin-113	90-6011	17:3/4 comp	< 0.369	n/r	<0.369
Antimony-125	90-6011	17:3/4 comp	< 0.146	n/r	<0.146
Cesium-134	90-6011	17:3/4 comp	< 0.0254	n/r	<0.0254
	90-5033	16:comp	0.00123	n/r	0.00123
Cesium-137	90-6011	17:3/4 comp	99.8	n/r	99.8
	90-5033	16:comp	7.70	n/r	7.70
Cerium-144	90-6011	17:3/4 comp	< 0.246	n/r	<0.246

Table B2-167. Tank 241-SY-102 February/March 1990 Push Mode Core Samples: Radionuclides.[1] (3 sheets)

Analyte[2]	Sample Number	Sample ID[3] (Core:Seg.)	Result	Duplicate	Mean
Centrifuged Sludge Liquid Fraction (Cont'd)			**μCi/mL**	**μCi/mL**	**μCi/mL**
Europium-152	90-6011	17:3/4 comp	< 0.00258	n/r	<0.00258
Europium-154	90-6011	17:3/4 comp	< 0.00365	n/r	<0.00365
Europium-155	90-6011	17:3/4 comp	< 0.0507	n/r	<0.0507
Gadolinium-153	90-6011	17:3/4 comp	< 0.0932	n/r	<0.0932
Neptunium-237	90-5033	16:comp	1.68E-06	n/r	1.68E-06
Uranium total (μg/mL)	90-5033	16:comp	7.97	n/r	7.97
Plutonium-238	90-5033	16:comp	4.11E-05	n/r	4.11E-05
Plutonium-239/240	90-5033	16:comp	2.28E-04	n/r	2.28E-04
Americium-241	90-5033	16:comp	0.00341	n/r	0.00341
Curium-243/244	90-5033	16:comp	2.75E-05	n/r	2.75E-05

Notes:

[1]Tingey and Sasaki (1995)

[2]Analysis dates: GEA radionuclides (^{60}Co, ^{106}Ru, ^{113}Sn, ^{125}Sb, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{152}Eu, ^{154}Eu, ^{155}Eu, ^{153}Gd, and ^{241}Am) are decay corrected to January 1, 1990. Tingey and Sasaki (1995) do not specify analysis dates; for the remaining radionuclides.

[3]Sample 17:3/4 comp = core 17, composite of segments 3 and 4; 16:comp = core 16 composite sample.

HISTORICAL SAMPLE DATA TABLES: 1988 CORE

Table B2-168. Tank 241-SY-102 October 1988 Push Mode Core Samples: Metals and Ions.[1] (2 sheets)

Analyte	Sample Results[2]			
	102-SY-3T4L[3]	102-SY-3T4L[4]	102-SY-3T4S[4]	102-SY-4B[4]
Metals	µg/mL	µg/mL[5]	µg/g	µg/g
Aluminum	3,320	3,060	34,800	48,000
Arsenic	2	n/r	n/r	<6,820
Barium	n/r	< 13	93	27
Boron	n/r	38	195	173
Calcium	37	46	5,690	421
Cerium	n/r	< 331	560	420
Chromium	416	368	16,400	13,300
Dysprosium	n/r	< 15	52	33
Iron	8.4	4	31,900	4,470
Lanthanum	n/r	< 33	139	81
Lithium	n/r	< 25	< 14	<14
Magnesium	n/r	< 9	1,730	97
Manganese	n/r	< 19	12,600	1,370
Molybdenum	n/r	23	77	<96
Neodymium	n/r	< 102	288	288
Nickel	n/r	48	528	294
Phosphorus	2,760	n/r	4,030	11,800
Potassium	1,430	1,430	2,310	2,380
Rhodium	n/r	< 364	< 412	<206
Ruthenium	n/r	< 596	< 404	<40
Selenium	0.2	n/r	n/r	<7,110
Silicon	17	27	2,700	843
Sodium	98,400	97,700	1.01E+05	1.94E+05
Strontium	n/r	< 21	175	18
Tellurium	n/r	< 301	< 255	<255

Table B2-168. Tank 241-SY-102 October 1988 Push Mode Core Samples: Metals and Ions.[1] (2 sheets)

Analyte	Sample Results[2]			
	102-SY-3T4L[3]	102-SY-3T4L[4]	102-SY-3T4S[4]	102-SY-4B[4]
Metals (Cont'd)	**μg/mL**	**μg/mL [5]**	**μg/g**	**μg/g**
Titanium	n/r	< 17	144	38
Uranium	10	n/r	n/r	1,300
Zinc	51	< 154	588	65
Zirconium	n/r	< 75	456	65
Ions	**μg/mL**	**μg/mL [5]**	**μg/g**	**μg/g**
Chromium (VI)	n/r	47.6	1,550	1,280
Hydroxide	12,900	n/r	n/r	17,000
Fluoride	< 513	n/r	n/r	1,650
Chloride	1,770	n/r	n/r	7,090
Nitrate	1.05E+05	n/r	n/r	2.02E+05
Nitrite	23,600	n/r	n/r	45,800
Phosphate	7,560	n/r	n/r	45,600
Sulfate	6,530	n/r	n/r	7,680
Miscellaneous				
Carbonate	25,800 μg/mL	n/r	n/r	0.0 μg/mL
TOC	2,200 μg C/mL	n/r	n/r	8,700 μgC/mL
Wt% water	75.2	n/r	n/r	n/r
Specific gravity	1.18	n/r	n/r	n/r

Notes:

n/r = not requested *or* not reported (this table only)

[1]Scheele and Peterson (1990), Weiss (1990)
[2]See Tables B2-13 and B2-14 for description of samples.
[3]222-S Laboratory data (Weiss 1990)
[4]325 Laboratory data (Scheele and Peterson 1990)
[5]Converted from original units of mmol/g using a specific gravity value of 1.18

Table B2-169. Tank 241-SY-102 October 1988 Push Mode Core Samples: Radionuclides.[1]

Analyte	Sample Results[2]				
	102-SY-3C	102-SY-3T4L	102-SY-3T4S	102-SY-T4C	102-SY-4B
Radionuclides	μCi/g	μCi/mL [3]	μCi/g	μCi/g	μCi/g
Tritium	n/r	< 9.39E-05	< 6.2E-04	n/r	<0.0013
Carbon-14	n/r	n/r	n/r	n/r	0.0018
Cobalt-60	n/r	n/r	n/r	n/r	0.11
Nickel-63	n/r	< 2.2E-04	< 5.5	n/r	<2.9
Selenium-79	n/r	7.16E-04	< 1.8E-04	n/r	3.18E-04
Strontium-90	n/r	0.00175	n/r	n/r	67.6
Niobium-94	n/r	< 3.7E-06	< 0.0023	n/r	<0.0041
Technetium-99	n/r	0.0635	0.22	n/r	0.202
Ruthenium-106	n/r	n/r	n/r	n/r	<1.6
Antimony-125	n/r	n/r	n/r	n/r	<1.6
Iodine-129	n/r	3.3E-05	2.4E-04	n/r	<2.4E-04
Cesium-134	n/r	n/r	n/r	n/r	<0.064
Cesium-137	n/r	3.90	n/r	n/r	150
Cerium-144	n/r	n/r	n/r	n/r	<1.1
Europium-152	n/r	n/r	n/r	n/r	<0.15
Europium-154	n/r	n/r	n/r	n/r	1.5
Neptunium-237	0.0013	n/r	n/r	8.1E-04	5.9E-04
Plutonium-238	1.35	n/r	n/r	0.788	0.037
Plutonium-239	9.73	n/r	n/r	2.82	0.13
Plutonium-239/240	n/r	1.6E-04	n/r	n/r	n/r
Plutonium-240	3.40	n/r	n/r	1.19	0.039
Plutonium-241	117	n/r	n/r	35.8	1.22
Americium-241	50.6	n/r	n/r	9.82	0.973
Curium-243/244	0.24	n/r	n/r	0.019	0.043

Notes:

n/r = not requested *or* not reported (this table only)

[1]Scheele and Peterson (1990)

[2]See Tables B2-13 and B2-14 for description of samples.

[3]325 Laboratory data converted from μCi/g to μCi/mL using a specific gravity value of 1.18.

Table B2-170. Tank 241-SY-102 October 1988 Push Mode Core Samples: Plutonium Isotopic Distributions.[1]

Isotope	102-SY-3C		102-SY-T4C		102-SY-4B	
	Atom%	Mass%	Atom%	Mass%	Atom%	Mass%
^{238}Pu	0.274	0.273	0.093	0.092	0.133	0.132
^{239}Pu	90.377	90.340	88.860	88.815	91.538	91.504
^{240}Pu	8.581	8.613	10.193	10.230	7.766	7.795
^{241}Pu	0.641	0.646	0.671	0.677	0.425	0.428
^{242}Pu	0.127	0.128	0.183	0.185	0.138	0.140

Note:

[1]Scheele and Peterson (1990)

Table B2-171. Tank 241-SY-102 October 1988 Push Mode Core Samples: Sludge Physical Measurements.[1]

Physical Property	Units	Sample[2]				
		3T4[3]	T4C	4B	4B (1:1)	4B (2:1)
Density	g/mL	1.29	1.52	1.80	1.42	1.29
Settled solids	vol%	n/r	n/r	100	58	38
Wt% water	wt%	n/r	n/r	32.7	53.3	63.5
Wt% oxide	wt%	n/r	n/r	38.4	n/r	n/r
Centrifuged solids	vol%	49.3	62	92	30	18
	wt%	54.2	60.2	93.9	35.4	20.9
	g/mL	1.42	n/r	n/r	n/r	n/r
Centrifuged liquids	g/mL	1.16	n/r	n/r	n/r	n/r

Notes:

vol% = volume percent

[1]Scheele and Peterson (1990) and Weiss (1990)

[2]Sample numbers all begin with prefix "102-SY-." See Tables B2-13 and B2-14 for description of samples. Samples 4B (1:1) and 4B (2:1) were 1:1 and 2:1 dilutions with deionized water:sample.

[3]Composite of Segment 3 and top section of Segment 4

Table B2-172. Tank 241-SY-102 October 1988 Push Mode Core Samples: Power Law Curve Fit Parameters.[1,2]

Sample[3] (dilution)	Temperature	Run	Yield Point (Pa)	Consistency Factor (Pa-s)	Flow Behavior Index
102-SY-4B (1:1)	30 °C (86 °F)	1	0	0.026	0.821
		2	0	0.028	0.817
102-SY-4B (2:1)	30 °C (86 °F)	1	0	0.013	0.808
		2	0	0.014	0.791

Notes:

[1]Scheele and Peterson (1990)

[2]Yield point, consistency factor, and flow behavior index were derived by least-squares fit of shear stress versus shear rate data to the power law equation:

$$\tau = \tau_y + k\gamma^n$$

where τ = shear stress (Pascals), τ_y = yield point (Pascals), k = consistency factor (Pascal-seconds), γ = shear rate (1/seconds), and n = flow behavior index (unitless).

[3]See Tables B2-13 and B2-14 for description of sample. Sample was diluted 1:1 and 2:1 with deionized water:sample.

Table B2-173. Tank 241-SY-102 October 1988 Push Mode Core Samples: Turbulent Flow Model Results.[1]

Sample[2] (dilution)	Pipe diameter (inch)	Critical Velocity m/s	Reynolds Number
102-SY-4B (1:1)	3.0	0.305	2,210
	2.0	0.403	2,210
102-SY-4B (2:1)	3.0	0.177	2,230
	2.0	0.232	2,230

Notes:

[1]Scheele and Peterson (1990)

[2]See Tables B2-13 and B2-14 for description of sample. Sample was diluted 1:1 and 2:1 with deionized water:sample.

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS

This section discusses the overall quality and consistency of the current sampling results for tank 241-SY-102, and it evaluates sampling and analysis factors that may impact data interpretation.

B3.1 ASSESSMENT OF JANUARY 1997 GRAB SAMPLE RESULTS

This section assesses the January 1997 grab sample results. Section B3.2 discusses the results from the July/August 1997 push mode core sampling of tank 241-SY-102.

B3.1.1 Field Observations: January 1997 Grab Samples

The SAP (Sasaki 1997a) prescribed that the samples be obtained at different depths to sample near the top, middle, and bottom of the supernatant. The SAP required no field blanks or sample duplicates, and none were collected. Three grab samples were obtained through riser 1A on January 14, 1997, using the "bottle-on-a-string" method (ASTM 1973). All three samples were intended to be supernatant samples. The top sample was sampled approximately 15 cm (6 in.) below the surface of the supernatant and the second sample approximately 320 cm (126 in.) below the surface of the supernatant (see Table B2-3). These two grab samples met the intent of the SAP to obtain near-surface and mid-level grab samples.

However, Table B2-3 indicates that sample 2SY-96-3 was a sludge sample consisting primarily of solids. The work package states that a sludge level measurement was to be performed before obtaining the deepest sample in order to verify that the sample would be obtained approximately 15 cm (6 in.) above the sludge level (LMHC 1997a). However, the work package does not record a sludge level measurement. The best-basis sludge volume estimate of 270 kL (71 kgal) converts to a waste depth of 66 cm (26 in.) (see Appendix D). Based on this waste depth, the sample elevation of 43 cm (17 in.) (see Table B2-2) indicates that sample 2SY-96-3 was taken 23 cm (9 in.) below the surface of the sludge. Because the deepest grab sample was primarily sludge and not liquid supernatant, the intent of the SAP to obtain a supernatant sample near the bottom of the supernatant was not met.

The 222-S Laboratory logged in the grab samples the same day the samples were acquired. Samples 2SY-96-1 and 2SY-96-2 were described as clear, yellow to dark-yellow, liquid samples. Sample 2SY-96-3 was described as containing opaque, dark brown solids. According to Nuzum (1997), sample 2SY-96-3 had insufficient supernatant to perform all analyses; therefore, the results reported for this sample are for information only. None of the samples had an identifiable separable organic layer.

Based on the differences in visual appearance and e rates of samples 2SY-96-1 and 2SY-96-2, the liquid waste in tank 241-SY-102 ap rs to be stratified. Because sample 2SY-96-3 retrieved sludge at a level of 43 cm (17), the sludge level may be inferred to be at least 43 cm deep under riser 1A.

B3.1.2 Quality Control Assessment: January 1997 Grab Samples

The usual QC assessment includes an evaluation of the appropriate standard recoveries, spike recoveries, duplicate analyses, and blanks that are performed in conjunction with the chemical analyses. All pertinent QC tests were conducted on January 1997 grab samples, allowing a full assessment regarding the accuracy and precision of the data. The SAP established specific criteria for all analytes (Sasaki 1997a). Sample and duplicate pairs with one or more QC results outside the specified criteria were identified by footnotes in the data summary tables; see Section B2.1.3 for the key to the QC footnotes.

The standard and spike recovery results provide an estimate of analysis accuracy. If a standard or spike recovery is above or below the given criterion, the analytical results may be biased high or low, respectively. The precision is estimated by the RPD, which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times 100.

The QC criteria specified in the SAP were as follows (Sasaki 1997a). For duplicate analyses, the allowed RPD was ≤20 percent. For the ICP, ^{90}Sr, and $^{239/240}Pu$ analyses, recommended percent recoveries for spikes were 75 to 125 percent. Percent recovery limit were not specified for the other analyses. Criteria for acceptable laboratory blanks were less than the estimated quantitation limit for ICP, and less than the minimum detectable activity for ^{90}Sr and $^{239/240}Pu$. Percent recoveries for laboratory control standards were 80 to 120 percent for DSC, TGA, ICP, IC, and TOC; 75 to 125 percent for ^{90}Sr; 70 to 130 percent for $^{239/240}Pu$; and not listed for the remaining analyses.

Quality control failures for these grab samples were minimal and should not affect the use of the data. Sample 2SY-96-1 (S97T000025) experienced a high RPD for ^{90}Sr, and sample 2SY-96-2 (S97T000026) had a low spike recovery for nitrate and a high RPD for sulfate. Sample 2SY-96-3 (S97T000029) experienced a high RPD for ^{60}Co; however, because sample 2SY-96-3 did not represent the supernatant, this QC failure is reported for information only. In summary, the majority of QC results were within the boundaries specified in the SAP.

B3.1.3 Data Consistency Checks: January 1997 Grab Samples

Comparing different analytical methods is helpful in assessing the consistency and quality of the data. Two comparisons were possible with the data set provided by the grab samples: a comparison of phosphorus and sulfur as determined by ICP to phosphate and sulfate as

measured by IC. In addition, mass and charge balances were calculated to help assess overall data consistency. All analytical mean results were taken from Table B3-8.

B3.1.3.1 Comparison of Results from Different Analytical Methods. The following data consistency checks compare the results from two analytical methods. Agreement between the two methods strengthens the credibility of both results, but poor agreement brings the reliability of the data into question.

The analytical phosphorus mean result as determined by ICP was 2,270 μg/mL, which converts to 6,960 μg/mL phosphate. This agrees well with the IC phosphate mean result of 6,450 μg/mL. The RPD between these two phosphate results is 7.6 percent.

The analytical sulfur mean result as determined by ICP was 655 μg/mL, which converts to 1,960 μg/mL sulfate. This is in reasonable agreement with the IC sulfate mean result of 2,240 μg/mL. The RPD between these two sulfate results is 13.2 percent.

B3.1.3.2 Mass and Charge Balance. The principal objective in performing mass and charge balances is to determine whether analytical measurements are consistent. In calculating the balances, only the analytes listed in Table B3-8 and detected at a concentration of 500 μg/mL or greater were considered. The following assumptions were used in calculating the balances: 1) aluminum existed as $Al(OH)_4^-$, 2) chromium existed as chromate, 3) the hydroxide measurement determined free hydroxide, 4) total inorganic carbon existed as carbonate, and 5) total organic carbon existed as acetate. The concentrations of cationic species in Table B3-1, the anionic species in Table B3-2, and the percent water were used to calculate the mass balance.

The mass balance was calculated from the following formula. The factor 0.0001 is the conversion factor from μg/g to weight percent, and the specific gravity term converts sample volume to sample mass.

$$\text{Mass balance} = \%\ \text{water} + 0.0001 \times \{\text{total analyte concentration in } \mu\text{g/mL}\}/\text{SpG}$$

$$= \%\ \text{water} + 0.0001 \times \{[K^+] + [Na^+] + 3.52[Al] + [F^-] + [Cl^-] + 2.23[Cr] + [OH^-] + [NO_3^-] + [NO_2^-] + [PO_4^{3-}] + [SO_4^{2-}] + 5.00[TIC] + 2.46[TOC]\}/1.08.$$

The total analyte concentration calculated from the above equation is 12.7 weight percent. The mean weight percent water is 87.2 weight percent. The mass balance that results from adding the weight percent water to the total analyte concentration is 99.9 percent (see Table B3-3).

The following equations were used to calculate the total cation and total anion charges. The charge balance is the absolute value of the cation-to-anion charges.

Total cations (μeq/g) = Σ(cation concentration/grams-per-equivalent)/SpG
= $\{[K^+]/39.10 + [Na^+]/22.99\}/1.08$
= 1,677 μeq/g

Total anions (μeq/g) = Σ(anion concentration/grams-per-equivalent)/SpG
= $\{3.52[Al]/95.01 + [F^-]/19.00 + [Cl^-]/35.45 + 2.23[Cr]/58.00 + [OH^-]/17.01 + [NO_3^-]/62.00 + [NO_2^-]/46.01 + [PO_4^{3-}]/31.66 + [SO_4^{2-}]/48.03 + 5.00[TIC]/30.00 + 2.46[TOC]/59.04\}/1.08$
= -1,854 μeq/g

The charge balance obtained by dividing the sum of the positive charge by the sum of the negative charge is 0.90. The net charge obtained by summing the positive and negative charge is -177 μeq/g (see Table B3-3).

In summary, the above calculations yield reasonable mass and charge balance values (close to 1.00 for charge balance and 100 percent for mass balance), indicating that the analytical results and supporting assumptions are generally consistent.

Table B3-1. January 1997 Grab Samples: Cation Mass and Charge Data.

Analyte	Mean Concentration[1] (μg/mL)	Assumed Species	Concentration of Assumed Species[2] (μg/g)	Charge (μeq/g)
Potassium	1,450	K^+	1,343	34
Sodium	40,800	Na^+	37,778	1,643
Total			39,121	1,677

Notes:
[1]From Table B3-8
[2]Converted from μg/mL to μg/g using the specific gravity mean value of 1.08.

Table B3-2. January 1997 Grab Samples: Anion Mass and Charge Data.

Analyte	Mean Concentration[1] (μg/mL)	Assumed Species	Concentration of Assumed Species[2] (μg/g)	Charge (μeq/g)
Aluminum	3,540	$Al(OH)_4^-$	11,542	-121
Fluoride	840	F^-	778	-41
Chloride	1,130	Cl^-	1,046	-30
Chromium	655	CrO_4^{2-}	1,353	-23
Hydroxide	4,760	OH^-	4,407	-259
Nitrate	45,500	NO_3^-	42,130	-679
Nitrite	10,500	NO_2^-	9,722	-211
Phosphate	6,450	PO_4^{3-}	5,972	-189
Sulfate	2,240	SO_4^{2-}	2,074	-43
TIC	1,500	CO_3^{2-}	6,939	-231
TOC	692	$C_2H_3O_2^-$	1,575	-27
Total			87,538	-1,854

Note:

[1]From Table B3-8.

[2]Converted from μg/mL to μg/g using the specific gravity mean value of 1.08.

Table B3-3. January 1997 Grab Samples: Mass and Charge Balance Totals.

Totals	Concentrations (μg/g)	Charge (μeq/g)
Total from Table B3-1 (cations)	39,121	1,677
Total from Table B3-2 (anions)	87,538	-1,854
Water	872,000	0
Total	998,659	-177
Cation/Anion Ratio	n/a	0.90

B3.2 ASSESSMENT OF JULY/AUGUST 1997 CORE SAMPLE RESULTS

This section assesses the July/August 1997 push mode core sample results.

B3.2.1 Field Observations: July/August 1997 Core Samples

The *Tank 241-SY-102 Push Mode Core Sampling and Analysis Plan* (Sasaki 1997b) governed the July/August 1997 push mode core sampling of the sludge layer in tank 241-SY-102. Three work packages (LMHC 1997b, 1997c and 1997d) describe the riser preparation and sampling events; Steen (1998) presents the 222-S Laboratory observations of the core samples. Sasaki prescribed that the bottom 97 cm (38 in.) of the tank waste be sampled. At the time of the core sampling, the tank contained approximately 270 kL (71 kgal) of solids and 2,320 kL (612 kgal) of supernatant.

Core 211 was obtained through riser 23A during July 23-28, 1997 and consisted of segments 11, 11R, and 12. Segment 11R was obtained when high downforces were encountered while taking segment 11 (LMHC 1997c). Segment 11R was obtained with the bottom of the segment at an elevation of about 48 cm (19 in.) from the tank bottom, and segment 12 was acquired with the bottom of the segment at an elevation of approximately 0 cm from the tank bottom. The SAP specified that the core segments should be delivered to the 222-S Laboratory within three days of collection. Segment 11 was sampled July 23 but was not delivered until August 12, segment 11R was sampled July 25 and delivered July 30, segment 12 was sampled July 28 and delivered July 30. Segment 11 was extruded August 14, and segments 11R and 12 were extruded August 4. With the possible exception of ammonia, the effect of the sample holding times on the analytical results was most likely minimal.

Core 113 was obtained through riser 17C during August 4-8, 1997 and consisted of segments 12R and 13. Segment 12R was taken after the sampler for segment 12 failed (LMHC 1997b). Segment 12R was obtained with the bottom of the sampler at an elevation of about 48 cm (19 in.) from the tank bottom, and segment 13 was acquired with the bottom of the sampler at an elevation of approximately 0 cm from the tank bottom. Segment 12R was sampled August 4, and segment 13 was sampled August 8; both samples were delivered to the 222-S Laboratory on August 12. Again, with the possible exception of ammonia, the effect of the sample holding times on the analytical results was most likely minimal.

On a volume basis, the extruded recoveries of the core segments ranged from 64 percent (core 213, segment 13) to 94 percent (core 211, segment 11R). The sampling work packages (LMHC 1997b and 1997c) indicate that the core segments were X-rayed for sample recovery. The work packages do not report the sample recoveries based on the sample X-rays; however, Brothers (1997) does report an analysis of the X-ray images for the selected segments of cores 211 and 213. The X-ray images of core 211, segment 11, and core 213, segment 12R, appeared to be uniform and did not show trapped gas, at least to the 1-mm (0.04-in.) resolution of the X-ray imaging and analysis system. A small amount of gas was present in

the segment as a gas gap between the top of the waste and the sampler piston. The X-ray image of core 213, segment 12, revealed that segment to be empty. Core 213, segment 13, exhibited a large amount of gas present in the form of trapped bubbles and in a gas gap between the waste and the sampler piston. These X-ray observations are consistent with the amount of condensed-phase waste recovered during the hot-cell extrusions.

A sample of the lithium bromide-traced HHF was included with core 211, and a deionized-water field blank was submitted with core 213. Steen (1998) indicates that HHF was recovered from the sample liners of core 211, segment 11, and core 213, segment 13, but no analyses were performed on the liner liquids because of the small quantities recovered. Based on the bromide determination, the upper and lower halves of core 213, segment 13, exhibited HHF contamination greater than 10 percent. The upper and lower halves of core 213, segment 13, exhibited an estimated 17 and 28 percent water intrusion from HHF, respectively. Table C2-1 in Appendix C shows the corrected water content for these two segment halves as well as the remaining solid and liquid sample portions.

B3.2.2 Quality Control Assessment: July/August 1997 Core Samples

The usual QC assessment includes an evaluation of the appropriate standard recoveries, spike recoveries, duplicate analyses, and blanks that were performed in conjunction with the chemical analyses. All pertinent QC tests were conducted on July/August 1997 core samples, allowing a full assessment regarding the accuracy and precision of the data. The SAP established specific criteria for all analytes (Sasaki 1997b). Sample and duplicate pairs with one or more QC results outside the specified criteria were identified by footnotes in the data summary tables; see Section B2.1.3 for the key to the QC footnotes.

The standard and spike recovery results provide an estimate of analysis accuracy. If a standard or spike recovery is above or below the given criterion, the analytical results may be biased high or low, respectively. The precision is estimated by the RPD, which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times 100.

Quality control failures for the core samples were minimal and should not affect the use of the data. The standard recovery for the ICP determination of silicon was high for all solid samples. Spike recovery failures for the ICP determination of sodium occurred for all solid and liquid samples; some spike recoveries were low, and others were high. A number of QC failures were noted for the total alpha activity determinations for the liquid samples, but most of these may be attributed to the fact that total alpha activity in these samples was near the detection limit. The field blank revealed no significant levels of sample contamination attributable to sample handling. In summary, the majority of QC results were within the boundaries specified in the SAP.

B3.2.3 Data Consistency Checks: July/August 1997 Core Samples

Comparing different analytical methods is helpful in assessing the consistency and quality of the data. A number of method comparisons were possible within the data set for the core samples; these comparisons are summarized in Section B3.2.3.1. In addition, mass and charge balances were calculated to help assess the overall data consistency.

B3.2.3.1 Comparison of Results from Different Analytical Methods. One type of data consistency check is the comparison of results from two or more analytical methods. Agreement among the methods strengthens the credibility of the results, but poor agreement brings the reliability of the data into question. Because ICP/MS data were available for the solid portions of the core samples, several comparisons with ICP and counting methods were possible. The comparisons available for the various methods are summarized in Table B3-4. All analytical mean results were taken from Table B3-9.

In summary, Table B3-4 shows that the data for the solid samples from tank 241-SY-102 are fairly consistent. This indicates that homogenization and subsampling of the solids appear to have been adequate. Some of the larger RPDs evident in Table B3-4, for example, sulfate, may be attributed to the statistical nature of the data and are not necessarily caused by failures in subsampling or analytical methods.

Table B3-4. Comparison of Methods for Tank 241-SY-102 July/August Core Sample Solids.[1] (2 sheets)

Analyte	Method 1	Mean Result	Method 2	Mean Result	RPD
Phosphate	ICP	27,902 μg/g [2]	IC	30,400 μg/g	8.6
Sulfate	ICP	3,476 μg/g [3]	IC	5,630 μg/g	47.3
Uranium total	ICP	1,280 μg/g	ICP/MS	1,420 μg/g [4]	10.4
$^{239/240}$Pu	Alpha	8.35 μCi/g	ICP/MS	5.93 μCi/g [5]	33.9
^{241}Am	Alpha	29.9 μCi/g	ICP/MS	22.5 μCi/g [6]	28.4
Total alpha activity	Alpha	28.4 μCi/g	ICP/MS	28.4 μCi/g [7]	0.0
Total alpha activity	Alpha	28.4 μCi/g	Alpha	38.3 μCi/g [8]	29.6

Table B3-4. Comparison of Methods for Tank 241-SY- 102 July/August Core Sample Solids.[1] (2 sheets)

Notes:

[1]All analytical mean results were taken from Table B3-9. Conversions to comparison values are explained in subsequent table footnotes. Specific activities used to convert isotopic concentrations in μg/g to activities in μCi/g are from Kirkpatrick and Brown (1984).

[2]Phosphate result derived from ICP phosphorus mean result of 9,100 μg/g.

[3]Sulfate result derived from ICP sulfur mean result of 1,160 μg/g.

[4]Sum of ^{235}U and ^{238}U ICP/MS mean values.

[5]Mean concentrations of ^{239}Pu (69.2 μg/g) and ^{240}Pu (7.22 μg/g) were individually converted from μg/g to μCi/g, then summed.

[6]Americium-241 result derived from ICP/MS $^{241}Pu/^{241}Am$ mean result of 6.55 μg/g; ^{241}Am was assumed to be the major contributor to mass 241.

[7]Mean concentrations of ^{239}Pu (69.2 μg/g), ^{240}Pu (7.22 μg/g), and $^{241}Pu/^{241}Am$ (6.55 μg/g) were individually converted from μg/g to μCi/g, then summed. Americium-241 was assumed to be the major contributor to mass 241.

[8]Sum of mean activities for $^{239/240}Pu$ (8.35 μCi/g) and ^{241}Am (29.9 μCi/g).

For the drainable liquid data, two comparisons were possible between the ICP and IC data. The ICP phosphorus mean value of 1,540 μg/mL converts to 4,720 μg/mL phosphate. This value is consistent with the IC phosphate value of 4,630 μg/mL; the RPD for the two values is 2.0 percent. The ICP sulfur mean value of 1,120 μg/mL converts to 3,360 μg/mL sulfate. This value is also consistent with the IC sulfate value of 3,490 μg/mL; the RPD for the two values is 3.9 percent. The mean values used in these comparisons are from Table B3-10.

B3.2.3.2 Mass and Charge Balance. The principal objective in performing mass and charge balances is to determine whether the measurements are consistent. In calculating the balances, only the analytes listed in Table B3-9 and detected at a concentration of 500 μg/g or greater were considered. The following assumptions were used in calculating the balances: 1) all metals except sodium and potassium existed as their neutrally charged hydroxides, 2) chromium existed as chromium (III), 3) manganese existed as manganese (IV), 4) iron existed as iron (III), 5) uranium existed as uranium (VI), and 6) silicon existed as the silicate ion (SiO_3^-). This data set contained no TIC, TOC, or caustic results with which to estimate the concentrations of carbonate, acetate, or hydroxide for the purposes of mass and charge balance.

The concentrations of cationic species in Table B3-5, the anionic species in Table B3-6, and the percent water were used to calculate the mass balance. The mass balance was calculated from the following formula.

Mass balance = % water + 0.0001 × total assumed analyte concentration in $\mu g/g$

= % water + 0.0001 × 2.89[Al] + 1.24[Bi] + 1.85[Ca] + 1.98[Cr] + 1.91[Fe] + 1.16[Pb] + 2.40[Mg] + 2.24[Mn] + [K] + [Na] + 1.43[U] + [F^-] + [Cl^-] + [NO_3^-] + [NO_2^-] + [oxalate^{2-}] + [PO_4^{3-}] + 2.71[Si] + [SO_4^{2-}].

The factor 0.0001 is the conversion factor from $\mu g/g$ to weight percent, [*X*] is the mean analytical value for analyte *X*, and the number preceding [*X*] converts the mean analytical value for *X* to the concentration of the assumed species of *X*. The total analyte concentration calculated from the above equation is 45.8 weight percent. The mean weight percent water is 58.2 weight percent. The mass balance resulting from adding the weight percent water to the total analyte concentration is 104 percent (see Table B3-7).

The following equations were used to calculate the total cation and total anion charges. The charge balance is the absolute value of the cation-to-anion charges.

Total cations ($\mu eq/g$) = Σ(cation concentration/grams-per-equivalent)
= [K]/39.10 + [Na]/22.99
= 3,498 $\mu eq/g$

Total anions ($\mu eq/g$) = Σ(anion concentration/grams-per-equivalent)
= [F^-]/19.00 + [Cl^-]/35.45 + [NO_3^-]/62.00 + [NO_2^-]/46.01 + [oxalate^{2-}]/44.01 + [PO_4^{3-}]/31.66 + 2.71[Si]/38.04 + [SO_4^{2-}]/48.03
= -4,386 $\mu eq/g$.

The charge balance obtained by dividing the sum of the positive charge by the sum of the negative charge is 0.80. The net charge obtained by summing the positive and negative charges is -888 $\mu eq/g$ (see Table B3-7).

The above calculations yield a reasonable mass balance of 104 percent (close to 100 percent), but the charge balance value of 0.80 may indicate a deficit of cation charge. A possible cation deficit may arise from two possible causes. One cause may be an overstatement of the anion charge by assuming that all metals other than sodium and potassium exist as hydroxides. Because the phosphate and sulfate values as determined by IC and ICP were similar (see Table B3-4), phosphate and sulfate species may be reasonably assumed to exist as soluble sodium and potassium salts. Some metals may exist as neutral species with fluoride or oxalate, but the concentrations of such species are not easily estimated with the available data.

A second possible cause of the cation deficit is underestimating the sodium and potassium concentrations in the sludge. The mean sodium and potassium values for the 1997 cores are 79,600 μg/g and 1,380 μg/g (see Table B3-9); these values contrast with the sodium and potassium concentrations of 145,000 μg/g and 2,890 μg/g based on the analysis of the February/March 1990 core (see Table D3-3). Because the upper 95 percent confidence limit for the means of the 1997 sodium and potassium values include the 1990 core values, the 1990 and 1997 sodium and potassium values may not be significantly different statistically.

Summarizing the mass and charge balance considerations, the deficit in cation charge may be attributed to the assumption that the non-sodium/potassium metals exist as hydroxides, thus overstating the total hydroxide content. The sludge data may also underestimate the sodium and potassium concentrations. Analytical data for possible major species such as hydroxide, carbonate (TIC), and TOC might facilitate a more exact mass and charge balance analysis, but these analytes were not determined for the 1997 cores.

Table B3-5. July/August 1997 Core Sample Solids: Cation Mass and Charge Data.[1]

Analyte	Mean Analyte Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge (μeq/g)
Aluminum	33,600	$Al(OH)_3$	97,137	0
Bismuth	1,280	$Bi(OH)_3$	1,593	0
Calcium	1,980	$Ca(OH)_2$	3,660	0
Chromium	12,400	$Cr(OH)_3$	24,568	0
Iron	13,200	$Fe(OH)_3$	25,260	0
Lead	1,010	$Pb(OH)_2$	1,176	0
Magnesium	579	$Mg(OH)_2$	1,389	0
Manganese	4,400	$Mn(OH)_4$	9,848	0
Potassium	1,380	K^+	1,380	35
Sodium	79,600	Na^+	79,600	3,462
Uranium	1,280	$U(OH)_6$	1,829	0
Total			247,440	3,498

Note:

[1]Mean analyte concentrations are from Table B3-9.

Table B3-6. July/August 1997 Core Sample Solids: Anion Mass and Charge Data.[1]

Analyte	Mean Analyte Concentration (μg/g)	Assumed Species	Concentration of Assumed Species (μg/g)	Charge (μeq/g)
Fluoride	1,700	F^-	1,700	-89
Chloride	2,460	Cl^-	2,460	-69
Nitrate	106,000	NO_3^-	106,000	-1,710
Nitrite	32,800	NO_2^-	32,800	-713
Oxalate	28,100	$(COO)_2^{2-}$	28,100	-638
Phosphate	30,400	PO_4^{3-}	30,400	-960
Silicon	1,240	SiO_3^{2-}	3,359	-88
Sulfate	5,630	SO_4^{2-}	5,630	-117
Total			210,449	-4,386

Note:
[1]Mean analyte concentrations are from Table B3-9.

Table B3-7. July/August 1997 Core Sample Solids: Mass and Charge Balance Totals.

Totals	Concentrations (μg/g)	Charge (μeq/g)
Total from Table B3-5 (cations)	247,440	3,498
Total from Table B3-6 (anions)	210,449	-4,386
Water	582,000	0
Total	1,039,889	-888
Cation/Anion Ratio	n/a	0.80

B3.3 MEAN CONCENTRATIONS AND CONFIDENCE INTERVALS

This section contains a summary of the statistical models and methods used to determine the mean values and 95 percent confidence intervals for the January 14, 1997, grab samples (see Section B3.3.1) and the July/August 1997 core samples (see Section B3.3.2). Appendix C contains a discussion of the statistical methods used to address the safety screening DQO issues.

B3.3.1 January 1997 Grab Sample Data

The model fit to the grab sample data was a nested analysis of variance (ANOVA) model; only data from the two supernatant samples, 2SY-96-1 and 2SY-96-2, were used in the model. The model determined the mean value and 95 percent confidence interval for each constituent. Two variance components were used in the calculations. The variance components represent concentration differences between samples taken from laboratory samples and between analytical replicates. The model is:

$$Y_{ij} = \mu + G_i + A_{ij},$$

$$I=1,2,\ldots,a;\ j=1,2,\ldots,n_i;$$

where

Y_{ij}	=	concentration from the j^{th} analytical result of the i^{th} grab sample
μ	=	the mean
G_i	=	the effect of the i^{th} grab sample
A_{ij}	=	the effect of the j^{th} analytical result of the i^{th} grab sample
a	=	the number of grab samples
n_i	=	the number of analytical results from the i^{th} grab sample.

The variable G_i is a random effect. This variable, along with A_{ij}, is assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(G)$, and $\sigma^2(A)$, respectively. The *df* associated with the standard deviation of the mean is the number of risers with data minus one.

Some analytes had results that were below the detection limit. In these cases, the value of the detection limit was used in computing the average. For analytes with a majority of results below the detection limit, a simple average is all that is reported. The average may be biased high when detection limits are included in the average.

Table B3-8. Tank 241-SY-102, January 14, 1997, Grab Samples: Means and 95 Percent Confidence Intervals.[1] (3 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Aluminum	ICP	3.54E+03	1	0.00E+00	2.35E+04	µg/mL
^{241}Am [2]	^{241}Am	<7.39E-06	n/a	n/a	n/a	µCi/mL
Ammonia[2]	ISE (NH_3)	3.80E+01	1	0.00E+00	5.05E+02	µg/mL
Antimony[2]	ICP	<9.08E+00	n/a	n/a	n/a	µg/mL
Arsenic[2]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
Barium[2]	ICP	<7.57E+00	n/a	n/a	n/a	µg/mL
Beryllium[2]	ICP	<7.58E-01	n/a	n/a	n/a	µg/mL

Table B3-8. Tank 241-SY-102, January 14, 1997, Grab Samples: Means and 95 Percent Confidence Intervals.[1] (3 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Bismuth[2]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
Boron[2]	ICP	<7.57E+00	n/a	n/a	n/a	µg/mL
Bromide[2]	IC	<4.55E+02	n/a	n/a	n/a	µg/mL
Cadmium[2]	ICP	9.35E-01	1	0.00E+00	6.40E+00	µg/mL
Calcium[2]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
Cerium[2]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
^{137}Cs	GEA	2.45E+01	1	0.00E+00	1.80E+02	µCi/mL
Chloride	IC	1.13E+03	1	0.00E+00	4.93E+03	µg/mL
Chromium	ICP	6.55E+02	1	0.00E+00	4.30E+03	µg/mL
Cobalt[2]	ICP	<3.02E+00	n/a	n/a	n/a	µg/mL
^{60}Co [2]	GEA	<6.40E-04	n/a	n/a	n/a	µCi/mL
Copper[2]	ICP	<1.51E+00	n/a	n/a	n/a	µg/mL
Fluoride	IC	8.40E+02	1	0.00E+00	3.93E+03	µg/mL
Hydroxide	OH direct	4.76E+03	1	0.00E+00	4.43E+04	µg/mL
Iron[2]	ICP	<7.57E+00	n/a	n/a	n/a	µg/mL
Lanthanum[2]	ICP	<7.57E+00	n/a	n/a	n/a	µg/mL
Lead[2]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
Lithium[2]	ICP	<1.51E+00	n/a	n/a	n/a	µg/mL
Magnesium[2]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
Manganese[2]	ICP	<1.51E+00	n/a	n/a	n/a	µg/mL
Molybdenum[2]	ICP	8.13E+00	1	0.00E+00	4.72E+01	µg/mL
Neodymium[2]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
Nickel[2]	ICP	<3.02E+00	n/a	n/a	n/a	µg/mL
Nitrate	IC	4.55E+04	1	1.04E+04	8.06E+04	µg/mL
Nitrite	IC	1.05E+04	1	0.00E+00	6.20E+04	µg/mL
Oxalate[2]	IC	<3.82E+02	n/a	n/a	n/a	µg/mL
pH measurement	pH	1.20E+01	1	1.11E+01	1.30E+01	unitless
Percent water	TGA	8.72E+01	1	7.06E+01	1.04E+02	wt%
Phosphate	IC	6.45E+03	1	0.00E+00	3.77E+04	µg/mL
Phosphorus	ICP	2.27E+03	1	0.00E+00	1.40E+04	µg/mL
$^{239/240}Pu$ [2]	$^{239/240}Pu$	9.60E-06	1	0.00E+00	8.07E-05	µCi/mL
Potassium	ICP	1.45E+03	1	0.00E+00	9.71E+03	µg/mL
Samarium[2]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL

Table B3-8. Tank 241-SY-102, January 14, 1997, Grab Samples: Means and 95 Percent Confidence Intervals.[1] (3 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Selenium[2]	ICP	<1.51E+01	n/a	n/a	n/a	μg/mL
Silicon	ICP	1.27E+01	1	0.00E+00	6.96E+01	μg/mL
Silver	ICP	2.91E+00	1	0.00E+00	8.72E+00	μg/mL
Sodium	ICP	4.08E+04	1	0.00E+00	1.18E+05	μg/mL
Specific gravity	SpG	1.08E+00	1	1.04E+00	1.12E+00	unitless
Strontium[2]	ICP	<1.51E+00	n/a	n/a	n/a	μg/mL
^{90}Sr	Sr	4.35E-03	1	0.00E+00	4.39E-02	μCi/mL
Sulfate	IC	2.24E+03	1	0.00E+00	4.92E+03	μg/mL
Sulfur	ICP	6.55E+02	1	0.00E+00	1.85E+03	μg/mL
Thallium[2]	ICP	<3.02E+01	n/a	n/a	n/a	μg/mL
Titanium[2]	ICP	<1.51E+00	n/a	n/a	n/a	μg/mL
TIC	TIC/TOC (Persulfate)	1.50E+03	1	1.37E+03	1.63E+03	μg/mL
TOC	TOC (Furnace)	6.92E+02	1	0.00E+00	4.85E+03	μg/mL
Uranium[2]	ICP	<7.52E+01	n/a	n/a	n/a	μg/mL
Vanadium[2]	ICP	<7.57E+00	n/a	n/a	n/a	μg/mL
Zinc[2]	ICP	<1.51E+00	n/a	n/a	n/a	μg/mL
Zirconium[2]	ICP	<1.51E+00	n/a	n/a	n/a	μg/mL

Notes:

LL = lower limit
UL = upper limit
ISE = ion-selective electrode

[1]Does not include results from sample 2-SY-96-3 (S97T000027, S97T000029).
[2]A less-than value was used in the calculations.

B3.3.2 July/August 1997 Push Mode Core Sample Data

B3.3.2.1 Solids Data. A nested ANOVA model was fit to the segment solids data. Mean values and 95 percent confidence intervals on the mean were determined from the ANOVA. Four variance components were used in the calculations. The variance components represent concentration differences between risers, segments, laboratory samples, and analytical replicates. The model is:

$$Y_{ijk} = \mu + R_i + S_{ij} + L_{ijk} + A_{ijkm},$$

$$I=1,2,\ldots,a;\ j=1,2,\ldots,b_i;\ k=1,2,\ldots,c_{ij};\ m=1,2,\ldots,n_{ijk}$$

where

Y_{ijkm} = concentration from the m^{th} analytical result of the k^{th} sample of the j^{th} segment of the i^{th} riser

μ = the mean

R_i = the effect of the i^{th} riser

S_{ij} = the effect of the j^{th} segment from the i^{th} riser

L_{ijk} = the effect of the k^{th} sample from the j^{th} segment of the i^{th} riser

A_{ijkm} = the analytical error

a = the number of risers

b_i = the number of segments from the i^{th} riser

c_{ij} = the number of samples from the j^{th} segment of the i^{th} riser

n_{ijk} = the number of analytical results from the ijk^{th} sample.

The variables R_i, S_{ij}, and L_{ijk} are random effects. These variables, as well as A_{ijkm}, are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(R)$, $\sigma^2(S)$, $\sigma^2(L)$, and $\sigma^2(A)$, respectively.

The restricted maximum likelihood method (REML) was used to estimate the mean concentration and standard deviation of the mean for all analytes that had 50 percent or more of their reported values greater than the detection limit. The mean value and standard deviation of the mean were used to calculate the 95 percent confidence intervals. Table B3-9 gives the mean, degrees of freedom, and confidence interval for each constituent.

Some analytes had results that were below the detection limit. In these cases, the value of the detection limit was used in computing the average. For analytes with a majority of results below the detection limit, a simple average is all that is reported. The average may be biased high when detection limits are included in the average.

The lower and upper limits, LL (95 percent) and UL (95 percent), of a two-sided 95 percent confidence interval on the mean were calculated using the following equation:

$$LL(95\%) = \hat{\mu} - t_{(df,\,0.025)} \times \hat{\sigma}(\hat{\mu}),$$
$$UL(95\%) = \hat{\mu} + t_{(df,\,0.025)} \times \hat{\sigma}(\hat{\mu}).$$

In this equation, $\hat{\mu}$ is the REML estimate of the mean concentration, $\hat{\sigma}(\hat{\mu})$ is the REML estimate of the standard deviation of the mean, and $t_{(df,\ 0.025)}$ is the quantile from Student's t distribution with *df* degrees of freedom. The degrees of freedom equals the number of risers with data minus one. In cases where the lower limit of the confidence interval was negative, it is reported as zero.

Table B3-9. Tank 241-SY-102 July/August Core Sample Solids: Means and 95 Percent Confidence Intervals. (3 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Aluminum	ICP:A	3.36E+04	1	0.00E+00	2.23E+05	µg/g
^{241}Am	AEA:F	2.99E+01	1	0.00E+00	3.28E+02	µCi/g
^{243}Am/^{243}Cm[1]	ICP/MS:A	<8.53E-02	n/a	n/a	n/a	µg/g
Antimony[1]	ICP:A	<1.80E+01	n/a	n/a	n/a	µg/g
Arsenic[1]	ICP:A	<3.00E+01	n/a	n/a	n/a	µg/g
Barium[1]	ICP:A	2.95E+01	1	0.00E+00	9.26E+01	µg/g
Beryllium[1]	ICP:A	2.66E+00	1	0.00E+00	1.15E+01	µg/g
Bismuth	ICP:A	1.28E+03	1	0.00E+00	1.05E+04	µg/g
Boron	ICP:A	1.28E+02	1	0.00E+00	3.66E+02	µg/g
Bromide[1]	IC:W	1.52E+03	1	0.00E+00	1.21E+04	µg/g
Cadmium	ICP:A	1.82E+02	1	0.00E+00	1.59E+03	µg/g
Calcium	ICP:A	1.98E+03	1	0.00E+00	1.39E+04	µg/g
Cerium[1]	ICP:A	7.59E+01	1	0.00E+00	3.26E+02	µg/g
Chloride	IC:W	2.46E+03	1	0.00E+00	1.48E+04	µg/g
Chromium	ICP:A	1.24E+04	1	0.00E+00	8.81E+04	µg/g
Cobalt	ICP:A	8.26E+00	1	0.00E+00	2.30E+01	µg/g
Copper[1]	ICP:A	2.72E+01	1	0.00E+00	2.69E+02	µg/g
Fluoride	IC:W	1.70E+03	1	0.00E+00	1.03E+04	µg/g
Total alpha activity	Alpha:F	2.84E+01	1	0.00E+00	2.98E+02	µCi/g
Iron	ICP:A	1.32E+04	1	0.00E+00	6.91E+04	µg/g

Table B3-9. Tank 241-SY-102 July/August Core Sample Solids: Means and 95 Percent Confidence Intervals. (3 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Lanthanum	ICP:A	8.11E+01	1	0.00E+00	4.11E+02	µg/g
Lead	ICP:A	1.01E+03	1	0.00E+00	4.69E+03	µg/g
Lithium	ICP:A	1.78E+01	1	0.00E+00	7.66E+01	µg/g
Magnesium	ICP:A	5.79E+02	1	0.00E+00	2.56E+03	µg/g
Manganese	ICP:A	4.40E+03	1	0.00E+00	1.73E+04	µg/g
Molybdenum	ICP:A	2.47E+01	1	0.00E+00	6.96E+01	µg/g
Neodymium[1]	ICP:A	1.13E+02	1	0.00E+00	5.38E+02	µg/g
^{237}Np	ICP/MS:A	1.54E+00	1	0.00E+00	7.01E+00	µg/g
Nickel	ICP:A	1.90E+02	1	0.00E+00	5.30E+02	µg/g
Nitrate	IC:W	1.06E+05	1	0.00E+00	6.36E+05	µg/g
Nitrite	IC:W	3.28E+04	1	0.00E+00	2.12E+05	µg/g
Oxalate[1]	IC:W	2.81E+04	1	0.00E+00	3.05E+05	µg/g
Percent water	TGA	5.82E+01	1	0.00E+00	1.47E+02	wt%
Phosphate	IC:W	3.04E+04	1	0.00E+00	2.30E+05	µg/g
Phosphorus	ICP:A	9.10E+03	1	0.00E+00	7.93E+04	µg/g
^{239}Pu	ICP/MS:A	6.92E+01	1	0.00E+00	7.03E+02	µg/g
$^{239/240}$Pu	$^{239/240}$Pu	8.35E+00	1	0.00E+00	8.82E+01	µCi/g
^{240}Pu	ICP/MS:A	7.22E+00	1	0.00E+00	7.27E+01	µg/g
^{241}Pu/^{241}Am	ICP/MS:A	6.55E+00	1	0.00E+00	6.61E+01	µg/g
^{242}Pu[1]	ICP/MS:A	1.76E-01	1	0.00E+00	9.49E-01	µg/g
^{244}Pu/^{244}Cm[1]	ICP/MS:A	<4.58E-02	n/a	n/a	n/a	µg/g
Potassium	ICP:A	1.38E+03	1	0.00E+00	4.79E+03	µg/g
Samarium[1]	ICP:A	<3.15E+01	n/a	n/a	n/a	µg/g
Selenium[1]	ICP:A	<3.15E+01	n/a	n/a	n/a	µg/g
Silicon	ICP:A	1.24E+03	1	0.00E+00	3.62E+03	µg/g
Silver	ICP:A	9.67E+01	1	0.00E+00	6.72E+02	µg/g
Sodium	ICP:A	7.96E+04	1	0.00E+00	3.05E+05	µg/g
Strontium	ICP:A	5.73E+01	1	0.00E+00	3.90E+02	µg/g
Sulfate	IC:W	5.63E+03	1	0.00E+00	2.93E+04	µg/g
Sulfur	ICP:A	1.16E+03	1	0.00E+00	3.66E+03	µg/g
Thallium[1]	ICP:A	<5.99E+01	n/a	n/a	n/a	µg/g

Table B3-9. Tank 241-SY-102 July/August Core Sample Solids: Means and 95 Percent Confidence Intervals. (3 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
^{229}Th[1]	ICP/MS:A	<8.29E-02	n/a	n/a	n/a	µg/g
^{230}Th[1]	ICP/MS:A	3.94E-01	1	0.00E+00	3.47E+00	µg/g
^{232}Th[1]	ICP/MS:A	4.23E+02	1	0.00E+00	3.18E+03	µg/g
Titanium	ICP:A	3.04E+01	1	0.00E+00	1.39E+02	µg/g
Uranium	ICP:A	1.28E+03	1	0.00E+00	8.13E+03	µg/g
^{233}U[1]	ICP/MS:A	8.63E-01	1	0.00E+00	6.10E+00	µg/g
^{234}U[1]	ICP/MS:A	<2.12E-01	n/a	n/a	n/a	µg/g
^{235}U	ICP/MS:A	9.92E+00	1	0.00E+00	5.79E+01	µg/g
^{236}U	ICP/MS:A	4.48E-01	1	0.00E+00	2.12E+00	µg/g
$_{238}U$	ICP/MS:A	1.41E+03	1	0.00E+00	8.91E+03	µg/g
Vanadium[1]	ICP:A	<1.50E+01	n/a	n/a	n/a	µg/g
Zinc	ICP:A	3.53E+02	1	0.00E+00	1.47E+03	µg/g
Zirconium	ICP:A	7.52E+01	1	0.00E+00	2.38E+02	µg/g

Note:

[1]A "less than value" was used in the calculations.

B3.3.2.2 Drainable Liquid Data. The model fit to the drainable liquid data was a nested ANOVA model. The model determined the mean value, and 95 percent confidence interval, for each constituent. Two variance components were used in the calculations. The variance components represent concentration differences between samples taken from the segments and between analytical replicates. The model is:

$$Y_{ij} = \mu + S_i + A_{ij},$$

$$I=1,2,\ldots,a;\ j=1,2,\ldots,n_i;$$

where

Y_{ij} = concentration from the j^{th} analytical result of the i^{th} segment
μ = the mean
S_i = the effect of the i^{th} segment
A_{ij} = the effect of the j^{th} analytical result of the i^{th} segment
a = the number of segments
n_i = the number of analytical results from the i^{th} segment.

The variable S_i is a random effect. This variable, along with A_{ij}, is assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(S)$ and $\sigma^2(A)$, respectively. The *df* associated with the standard deviation of the mean is the number of risers with data minus one.

Table B3-10. Tank 241-SY-102 July/August Core Sample Drainable Liquids: Means and 95 Percent Confidence Intervals. (2 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Aluminum	ICP	3.56E+03	1	0.00E+00	1.28E+04	µg/mL
Ammonia[1]	ISE (NH_3)	5.00E+01	1	0.00E+00	2.87E+02	µg/mL
Antimony[1]	ICP	<1.81E+01	n/a	n/a	n/a	µg/mL
Arsenic[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Barium[1]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
Beryllium[1]	ICP	<1.50E+00	n/a	n/a	n/a	µg/mL
Bismuth[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Boron[1]	ICP	2.24E+01	1	0.00E+00	7.92E+01	µg/mL
Bromide[1]	IC	5.29E+02	1	0.00E+00	1.85E+03	µg/mL
Cadmium	ICP	8.67E+00	1	0.00E+00	5.77E+01	µg/mL
Calcium[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Cerium[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Chloride	IC	1.91E+03	1	0.00E+00	4.51E+03	µg/mL
Chromium	ICP	7.93E+02	1	0.00E+00	1.59E+03	µg/mL
Cobalt[1]	ICP	<6.02E+00	n/a	n/a	n/a	µg/mL
Copper[1]	ICP	<3.01E+00	n/a	n/a	n/a	µg/mL
Fluoride	IC	5.35E+02	1	0.00E+00	1.74E+03	µg/mL
Total alpha activity[1]	Alpha rad	3.00E-02	1	0.00E+00	2.33E-01	µCi/mL
Iron[1]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
Lanthanum[1]	ICP	<1.51E+01	n/a	n/a	n/a	µg/mL
Lead[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Lithium[1]	ICP	8.26E+00	1	0.00E+00	4.50E+01	µg/mL
Magnesium[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Manganese[1]	ICP	<3.01E+00	n/a	n/a	n/a	µg/mL
Molybdenum[1]	ICP	2.46E+01	1	0.00E+00	1.02E+02	µg/mL
Neodymium[1]	ICP	<3.01E+01	n/a	n/a	n/a	µg/mL
Nickel[1]	ICP	<6.02E+00	n/a	n/a	n/a	µg/mL
Nitrate	IC	7.18E+04	1	0.00E+00	2.51E+05	µg/mL
Nitrite	IC	2.32E+04	1	0.00E+00	7.52E+04	µg/mL
Oxalate[1]	IC	<5.30E+02	n/a	n/a	n/a	µg/mL

Table B3-10. Tank 241-SY-102 July/August Core Sample Drainable Liquids: Means and 95 Percent Confidence Intervals. (2 sheets)

Analyte	Method	$\hat{\mu}$	df	LL	UL	Units
Percent water	TGA	8.15E+01	1	4.92E+01	1.14E+02	wt%
Phosphate	IC	4.63E+03	1	0.00E+00	1.74E+04	μg/mL
Phosphorus	ICP	1.54E+03	1	0.00E+00	6.01E+03	μg/mL
Potassium	ICP	2.42E+03	1	2.06E+03	2.79E+03	μg/mL
Samarium[1]	ICP	<3.01E+01	n/a	n/a	n/a	μg/mL
Selenium[1]	ICP	<3.01E+01	n/a	n/a	n/a	μg/mL
Silicon	ICP	8.49E+01	1	0.00E+00	2.63E+02	μg/mL
Silver	ICP	4.88E+00	1	0.00E+00	1.46E+01	μg/mL
Sodium	ICP	6.70E+04	1	0.00E+00	1.82E+05	μg/mL
Specific gravity	SpG	1.15E+00	1	8.66E-01	1.43E+00	unitless
Strontium[1]	ICP	<3.01E+00	n/a	n/a	n/a	μg/mL
Sulfate	IC	3.49E+03	1	0.00E+00	1.51E+04	μg/mL
Sulfur	ICP	1.12E+03	1	0.00E+00	5.42E+03	μg/mL
Thallium[1]	ICP	<6.02E+01	n/a	n/a	n/a	μg/mL
Titanium[1]	ICP	<3.01E+00	n/a	n/a	n/a	μg/mL
Uranium[1]	ICP	<1.50E+02	n/a	n/a	n/a	μg/mL
Vanadium[1]	ICP	<1.51E+01	n/a	n/a	n/a	μg/mL
Zinc	ICP	5.63E+00	1	0.00E+00	1.88E+01	μg/mL
Zirconium[1]	ICP	<3.01E+00	n/a	n/a	n/a	μg/mL

Note:

[1]A "less than value" was used in the calculations.

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

Appendix C documents the results of the analyses and statistical and numerical manipulations required by the DQOs applicable for tank 241-SY-102. The analyses required for tank 241-SY-102 are reported as follows.

- **Section C1.0**: Statistical analysis and numerical manipulations supporting the safety screening DQO (Dukelow et al. 1995) as applied to the July/August 1997 push mode core samples.
- **Section C2.0**: Evaluation of HHF contamination in the July/August 1997 push-mode core samples.
- **Section C3.0**: Appendix C References.

C1.0 STATISTICS FOR THE SAFETY SCREENING DATA QUALITY OBJECTIVE: JULY/AUGUST 1997 PUSH MODE CORE SAMPLES

The safety screening DQO (Dukelow et al. 1995) defines decision limits in terms of one-sided 95 percent confidence intervals. The safety screening limits are 1 g/L for ^{239}Pu and 480 J/g (dry-weight basis) for DSC. For the July/August 1997 core sample solids with a bulk density of 1.64 g/mL, the 1 g/L ^{239}Pu limit corresponds to 610 μg/g or 37.5 μCi/g.

Confidence intervals on the mean were calculated for each laboratory sample. The data used in the computations were from the data package for the July/August 1997 core sampling event (Steen 1998). The means and confidence intervals for total alpha activity and the plutonium isotopes are given in Tables C1-1 through C1-5. No statistics were done on the DSC data because there were no exothermic reactions in any of the DSC samples.

The upper limit (UL) of a one-sided 95 percent confidence interval on the mean is

$$\hat{\mu} + t_{(df,0.05)}\, \hat{\sigma}_{\hat{\mu}}.$$

In this equation, $\hat{\mu}$ is the arithmetic mean of the data, $\hat{\sigma}_{\hat{\mu}}$ is the estimate of the standard deviation of the mean, and $t_{(df,0.05)}$ is the quantile from Student's t distribution with df degrees of freedom for a one-sided 95 percent confidence interval. The degrees of freedom equals the number of samples minus one.

Each confidence interval can be used to make the following statement. If the upper limit is less than 37.5 μCi/g, then one would reject the null hypothesis that the total alpha activity is greater than or equal to 37.5 μCi/g at the 0.05 level of significance.

For the total alpha activity data, core 211, segment 11 solids, lower half, had a mean total alpha activity value of 91.0 μCi/g with a maximum upper bound of the 95 percent confidence interval of 103 μCi/g. Both values are above the threshold limit of 37.5 μCi/g. However, the majority of this alpha activity was caused by ^{241}Am. The ^{241}Am mean activity for core 211, segment 11 solids, lower half, was 99.6 μCi/g. For the same sample, the upper bound of the 95 percent confidence interval for $^{239/240}$Pu (as determined by alpha counting) was 31.2 μCi/g; this value is less than the computed 37.5 μCi/g threshold limit. For the same sample, the upper bound of the 95 percent confidence interval for ICP/MS ^{239}Pu was 247 μg/g; this value is less than the computed 610 μg/g threshold limit.

In summary, the upper bound of the 95 percent confidence interval for one sample exceeded the computed total alpha activity threshold. The majority of the alpha activity in the sample was caused by ^{241}Am; the safety screening threshold was not exceeded based on actual plutonium values. No other samples exhibited total alpha activities that exceeded the safety screening threshold.

Table C1-1. Tank 241-SY-102 July/August 1997 Core Samples: 95 Percent Upper Confidence Limits for Total Alpha Activity.

Lab Sample ID	Description	$\hat{\mu}$	df	UL	Units
S97T001917	Core 211, segment 11R	2.08E-03	1	5.99E-03	μCi/mL
S97T001933	Core 211, segment 12	5.20E-03	1	6.12E-03	μCi/mL
S97T001972[1]	Core 211, segment 11	4.46E-02	1	7.09E-02	μCi/mL
S97T001977[1]	Core 213, segment 12R	6.82E-02	1	1.46E-01	μCi/mL
S97T001987	Core 213, segment 13, lower half	2.66E+00	1	3.04E+00	μCi/g
S97T001995	Core 211, segment 11, lower half	9.10E+01	1	1.03E+02	μCi/g
S97T001996	Core 211, segment 11, upper half	1.83E+01	1	2.11E+01	μCi/g
S97T001998	Core 211, segment 12, lower half	1.72E+00	1	2.50E+00	μCi/g

Note:

[1]A "less-than value" was used in the calculations.

Table C1-2. Tank 241-SY-102 July/August 1997 Core Sample Solids: 95 Percent Upper Confidence Limits for Plutonium-239/240 by Alpha Counting.

Lab Sample ID	Description	$\hat{\mu}$	df	UL	Units
S97T001987	Core 213, segment 13, lower half	4.69E-01	1	4.82E-01	μCi/g
S97T001995	Core 211, segment 11, lower half	2.68E+01	1	3.12E+01	μCi/g
S97T001996	Core 211, segment 11, upper half	5.86E+00	1	6.65E+00	μCi/g
S97T001998	Core 211, segment 12, lower half	2.83E-01	1	3.02E-01	μCi/g

Table C1-3. Tank 241-SY-102 July/August 1997 Core Sample Solids: 95 Percent Upper Confidence Limits for Plutonium-239 by ICP/MS.

Lab Sample ID	Description	$\hat{\mu}$	df	UL	Units
S97T001895	Core 211, segment 11, lower half	2.44E+02	1	2.47E+02	μg/g
S97T001912	Core 211, segment 11, upper half	9.04E+01	1	9.16E+01	μg/g
S97T001924	Core 211, segment 12, lower half	3.94E+00	1	4.27E+00	μg/g
S97T001929	Core 211, segment 12, upper half	5.11E+00	1	5.43E+00	μg/g
S97T001988	Core 213, segment 13, lower half	6.54E+01	1	7.04E+01	μg/g
S97T001990	Core 213, segment 13, upper half	6.05E+00	1	6.36E+00	μg/g

Table C1-4. Tank 241-SY-102 July/August 1997 Core Sample Solids: 95 Percent Upper Confidence Limits for Plutonium-240 by ICP/MS.

Lab Sample ID	Description	$\hat{\mu}$	df	UL	Units
S97T001895	Core 211, segment 11, lower half	2.74E+01	1	2.75E+01	μg/g
S97T001912	Core 211, segment 11, upper half	7.27E+00	1	7.37E+00	μg/g
S97T001924	Core 211, segment 12, lower half	3.20E-01	1	3.46E-01	μg/g
S97T001929	Core 211, segment 12, upper half	4.59E-01	1	4.69E-01	μg/g
S97T001988	Core 213, segment 13, lower half	7.35E+00	1	7.74E+00	μg/g
S97T001990	Core 213, segment 13, upper half	5.29E-01	1	6.18E-01	μg/g

Table C1-5. Tank 241-SY-102 July/August 1997 Core Sample Solids: 95 Percent Upper Confidence Limits for Plutonium-242 by ICP/MS.[1]

Lab Sample ID	Description	$\hat{\mu}$	df	UL	Units
S97T001895	Core 211, segment 11, lower half	4.77E-01	1	4.93E-01	μg/g
S97T001912	Core 211, segment 11, upper half	9.34E-02	1	1.11E-01	μg/g
S97T001988	Core 213, segment 13, lower half	1.25E-01	1	1.43E-01	μg/g

Note:

[1]The results for samples S97T001929 (core 211, segment 12, upper half), S97T001924 (core 211, segment 12, lower half), and S97T001990 (core 213, segment 13, upper half) were all less-than values and are not included in this table.

C2.0 EVALUATION OF HYDROSTATIC HEAD FLUID CONTAMINATION: JULY/AUGUST 1997 PUSH MODE CORE SAMPLES

The July/August 1997 push mode core samples from tank 241-SY-102 exhibited traces of lithium and bromide, thus providing evidence of HHF intrusion in the waste samples. Tables B2-90 and B2-111 show the analytical results for lithium and bromide. Based on the data, corrected water contents for the contaminated samples were calculated. Winkleman (1996) provides the methodology for correction of water intrusion from HHF based on the amounts of lithium and bromide tracers found in the samples. The remainder of this section provides an evaluation of the extent of HHF intrusion into the July/August core samples.

A sample of the HHF used in the July/August 1997 sampling event was delivered to the 222-S Laboratory with the core samples. For the HHF sample, the mean analytical bromide result was 21,440 μg/mL; the mean analytical lithium result was 1,940 μg/mL.

According to Bechtold (1995), lithium ion may form insoluble precipitates with other constituents in the sample. Consequently, the lithium concentration in a sample does not provide a good quantitative correction for the amount of HHF intrusion in the sample. Therefore, this treatment corrects the water content based only on bromide data. Table C2-1 lists the analytical results of bromide and the associated corrected water content for each sample. The corrections were calculated according to Winkelman (1996).

The results in Table C2-1 show the highest HHF water contaminations are 17.1 percent for core 13, segment 13, upper half solids and 27.9 percent for core 13, segment 13, lower half solids. The corrected weight percent water values for these two samples are 59.1 and 32.0 weight percent, respectively. Those samples with HHF water contaminations of less than 10 percent do not need correction, and the corrected values in Table C2-1 for those samples

are shown for information only (Kristofzski 1995). Because the DSC analyses revealed no exotherms, no corrections are necessary for the DSC data.

Table C2-1. Weight Percent Water Correction Based on Bromide Results for Tank 241-SY-102, July/August 1997 Push Mode Core Samples.

Sample				Water		
Number	Location	Portion	Mean Bromide Conc.[1]	Percent Water from HHF	Mean Uncorrected wt% Water[2]	Corrected wt% Water
Solids			µg/g			
S97T001913	211:11R	Upper half	<516	<3.14	76.2	n/c
S97T001908		Lower half	547	3.71	68.3	67.5
S97T001930	211:12	Upper half	<1,230	<11.1	51.4	n/c
S97T001925		Lower half	<510	<4.66	50.7	n/c
S97T001991	213:13	Upper half	2,340	17.1	63.3	59.1
S97T001989		Lower half	2,380	27.9	39.4	32.0
Liquids			µg/mL			
S97T001973	211:11	Drainable liquid	<518	<2.52	84.9	n/c
S97T001918	211:11R	Drainable liquid	270	1.36	82.9	82.8
S97T001934	211:12	Drainable liquid	779	4.0	74.0	73.3
S97T001978	213:12R	Drainable liquid	549	2.62	84.2	83.8

Notes:

conc. = concentration
n/c = not corrected

[1]Values for mean bromide concentration are from Table B2-111.
[2]Values for uncorrected weight percent water are from Table B2-119.

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS STANDARD INVENTORY FOR DOUBLE-SHELL TANK 241-SY-102

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-SY-102

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for double-shell tank 241-SY-102 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Available waste information for tank 241-SY-102 includes the following:

- The information included in Appendices A and B of this TCR for tank 241-SY-102 on tank history, sampling, analyses, and data evaluation
- An assessment of the sludge level in tank 241-SY-102 based on sludge weight measurements and recoveries from grab sampling and core sampling events
- The HDW model inventory estimates for this tank (Agnew et al. 1997a).

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Tank 241-SY-102 is the only active tank in the 200 West Area. The tank routinely receives wastes from the 200 West Area operations and serves as the staging tank for cross-site transfers to the 200 East Area double-shell tank farms. Because the liquid volume in this tank is frequently changing, the HDW model supernatant inventory is no longer valid and is not considered in this section. However, the tank also contains a sludge layer that was core sampled in 1988, 1990, and 1997 (see Appendix B). The data from the 1997 core sampling were used to establish a sample-based inventory estimate for the sludge layer, and these data are compared with the TLM portion of the HDW model for tank 241-SY-102.

The HDW TLM inventory estimates for the sludge layer in tank 241-SY-102 are listed in Tables D2-1 and D2-2. The TLM model results are based on a sludge volume of 268 kL

(70.9 kgal) (Agnew et al. 1997a). Also included in Tables D2-1 and D2-2 are the previous best-basis inventory estimate for the sludge and inventory estimates calculated from Table B3-9 of this TCR. The previous best-basis inventory estimate is based on a sludge volume of 330 kL (88 kgal) (LMHC 1998a). The sample-based inventory estimates are based on a sludge volume of 270 kL (71 kgal) (see Section D3.3.1). The chemical species are reported without charge designation according to the best-basis inventory convention.

Table D2-1. Tank 241-SY-102 Sludge Layer Non-Radionuclide Components: Hanford Defined Waste Model and Sample-Based Inventory Estimates. (2 sheets)

Analyte	HDW TLM Inventory Estimate[1] (kg)	Previous Best-Basis Estimate[2] (kg)	Sample-Based Inventory Estimate[3] (kg)
Al	40,100	15,000	13,000
Bi	189	198	495
Ca	2,370	3,620	766
Cl	909	935	952
Cr	1,900	10,200	4,800
CO_3	10,600	6,080	n/r
F	361	267	658
Fe	13,100	12,900	5,110
Hg	0.765	0.805	n/r
K	823	1,530	534
La	0.368	38.0	31.4
Mn	20.5	3,430	1,700
Na	85,000	61,800	30,800
Ni	1,010	325	73.5
NO_2	30,000	11,000	12,700
NO_3	59,800	39,600	41,000
OH	113,000	n/r	n/r
Pb	71.8	972	391
PO_4	5,060	11,700	11,800
Si	326	4,320	480
SO_4	9,870	2,640	2,180
Sr	0.00	69.6	22.2
TOC	4,050	2,230	n/r

Table D2-1. Tank 241-SY-102 Sludge Layer Non-Radionuclide Components: Hanford Defined Waste Model and Sample-Based Inventory Estimates. (2 sheets)

Analyte	HDW TLM Inventory Estimate[1] (kg)	Previous Best-Basis Estimate[2] (kg)	Sample-Based Inventory Estimate[3] (kg)
U_{total}	285	618	550[4]
Zr	9.20	234	29.1
H_2O (wt%)	25.5	n/r	58.2
Density (g/mL)	1.84	1.56	1.44

Notes:

[1]Agnew et al. (1997a). Estimated sludge volume = 268 kL (70.9 kgal).

[2]LMHC (1998a). Estimated sludge volume = 330 kL (88 kgal).

[3]Based on 1997 core sample results in Table B3-9. Estimated sludge volume = 270 kL (71 kgal) and density = 1.44 g/mL; density is average of values in Table B2-120, Appendix B.

[4]Computed from the sum of ICP/MS results for ^{235}U and ^{238}U.

Table D2-2. Tank 241-SY-102 Sludge Layer Radioactive Components: Hanford Defined Waste Model and Sample-Based Inventory Estimates. (3 sheets)

Analyte	HDW TLM Inventory Estimate[1] (Ci)	Previous Best-Basis Estimate[2] (Ci)	Sample-Based Inventory Estimate[3] (Ci)
^{3}H	74.0	0.279	n/r
^{14}C	9.59	0.852	n/r
^{59}Ni	0.164	0.173	n/r
^{60}Co	6.84	58.7	n/r
^{63}Ni	16.1	17.0	n/r
^{79}Se	0.609	0.639	n/r
^{90}Sr	12,000	38,900	n/r
^{90}Y	12,000	38,900	n/r
^{93}Zr	2.99	3.14	n/r
^{93m}Nb	2.18	2.30	n/r
^{99}Tc	85.1	20.2	n/r
^{106}Ru	0.00115	0.00121	n/r
^{113m}Cd	15.5	16.3	n/r

Table D2-2. Tank 241-SY-102 Sludge Layer Radioactive Components: Hanford Defined Waste Model and Sample-Based Inventory Estimates (3 sheets)

Analyte	HDW TLM Inventory Estimate[1] (Ci)	Previous Best-Basis Estimate[2] (Ci)	Sample-Based Inventory Estimate[3] (Ci)
^{125}Sb	30.1	31.6	n/r
^{126}Sn	0.921	0.972	n/r
^{129}I	0.164	0.173	n/r
^{134}Cs	0.879	0.925	n/r
^{137}Cs	92,500	37,700	n/r
^{137m}Ba	87,500	35,664	n/r
^{151}Sm	2,150	2,260	n/r
^{152}Eu	0.741	0.779	n/r
^{154}Eu	108	566	n/r
^{155}Eu	44.0	493	n/r
^{226}Ra	2.72E-05	2.86E-05	n/r
^{227}Ac	1.67E-04	1.76E-04	n/r
^{228}Ra	0.0194	0.0204	n/r
^{229}Th	4.70E-04	4.95E-04	<6.82
^{231}Pa	7.49E-04	7.90E-04	n/r
^{232}Th	0.00214	0.00225	0.0180
^{232}U	0.0467	0.0491	n/r
^{233}U	0.179	0.189	3.22
^{234}U	0.100	0.105	<0.513
^{235}U	0.00420	0.00442	0.0100
^{236}U	0.00241	0.00254	0.0112
^{237}Np	0.311	0.327	0.420
^{238}U	0.124	0.130	0.183
^{238}Pu	0.151	348	n/r
^{239}Pu	2,640	n/r[4]	2,340[5]
^{240}Pu	659	n/r[4]	894[5]
^{241}Pu	10.1	10.7	n/r
^{241}Am	2,780	24,800	11,600
^{242}Pu	5.48E-05	5.77E-05	0.268

Table D2-2. Tank 241-SY-102 Sludge Layer Radioactive Components: Hanford Defined Waste Model and Sample-Based Inventory Estimates. (3 sheets)

Analyte	HDW TLM Inventory Estimate[1] (Ci)	Previous Best-Basis Estimate[2] (Ci)	Sample-Based Inventory Estimate[3] (Ci)
^{242}Cm	6.11E-05	6.44E-05	n/r
^{243}Am	6.70E-04	7.07E-04	n/r
^{243}Cm	1.25E-06	1.31E-06	n/r
^{244}Cm	3.63E-05	3.82E-05	n/r

Notes:

[1]Agnew et al. (1997a). Estimated sludge volume = 268 kL (70.9 kgal) and decay corrected to January 1, 1994.

[2]LMHC (1998a). Estimated sludge volume = 330 kL (88 kgal) and decay corrected to January 1, 1994.

[3]Converted from the 1997 core sample results in Table B3-9. Estimated sludge volume = 270 kL (71 kgal), density = 1.44 g/mL, decay-corrected from October 15, 1997, to January 1, 1994; specific activities for converting from mass basis to curie basis are from Kirkpatrick and Brown (1984).

[4]An inventory value of 3,170 Ci for the hybrid species $^{239/240}Pu$ was reported.

[5]Computed from the $^{239/240}Pu$ alpha count mean result and ratioed to the ^{239}Pu and ^{240}Pu results as determined by ICP/MS.

D3.0 COMPONENT INVENTORY EVALUATION

The general approach in the component inventory evaluation is to use all available information to formulate the best-basis estimate of the tank's contents. The evaluation considers the waste history of the tank and may include analytical data from samples taken from the tank of interest, analytical data from other tanks containing waste types thought to be similar to those in the tank of interest, and data from models based upon historical process records.

D3.1 WASTE HISTORY FOR TANK 241-SY-102

Agnew et al. (1997b) and Koreski (1998) summarize the waste transfer history of tank 241-SY-102. Tank 241-SY-102 entered service in the second quarter of 1977; from that time until 1981, Agnew et al. (1997b) indicates the tank mostly received supernatant from

the 241-S, -SX, -T, -TX, and -U tank farms. During this time, tank 241-SY-102 was also a feed tank for the 242-S Evaporator; output from the evaporator was routed to other 241-SY tanks and to tanks in the 241-A, -S, -SX, and -U tank farms.

Since the last 242-S Evaporator campaign in 1980, tank 241-SY-102 received supernatant from other 200 West Area tanks and processes and was the staging tank for cross-site transfers to 200 East Area double-shell tanks. From the first quarter of 1981 to the second quarter of 1994, the tank received waste from the PFP laboratory and the 222-S Laboratory. From the first quarter of 1981 to the first quarter of 1990, the tank received decontamination waste from T Plant. From the first quarter of 1981 to the third quarter of 1995, supernatant waste was transferred from tank 241-SY-102 to various 200 East Area double-shell tanks. From the fourth quarter of 1981 to the fourth quarter of 1983, the tank received salt well liquid from various 200 West Area single-shell tanks. From the second quarter of 1982 through the first quarter of 1992, tank 241-SY-102 received dilute noncomplexed waste from the PFP. In 1982 the tank received a single transfer of dilute noncomplexed liquid from the 300 and 400 Area laboratories.

From the second quarter of 1983 through the first quarter of 1988, tank 241-SY-102 received TRU waste from the PFP. These additions of TRU waste are likely the source of the TRU content now found in the sludge layer in tank 241-SY-102. In 1985, the tank received a single transfer of dilute phosphate waste from the 231-Z laboratories and salt well liquid from an unknown tank. In 1993, the tank again began receiving salt well liquid from 200 West Area single-shell tanks. For most of the tank's history, the tank received flush water from miscellaneous sources. Transfer of waste to tank 241-SY-102 is and will continue to be an ongoing activity. From April 1997 through May 1998, the tank received a total of 300 kL (80 kgal) of salt well liquid and flush water in six transfers that ranged from 19 kL (5 kgal) to 76 kL (20 kgal).

D3.2 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT

The sludge layer in tank 241-SY-102 is believed to be primarily a combination of solids coming from 242-S Evaporator, PFP and T Plant decontamination operations. Agnew et al. (1997a) identified the solids as including 155 kL (41 kgal) of S2SltCk, 95 kL (25 kgal) of Z Plant waste, and 19 kL (5 kgal) of DW from T Plant.

Agnew et al. (1997a) lists the HDW model nonradioactive compositions of each waste type by weight. (In the following discussion, the component weight percents may not total exactly 100 percent either because the minor [less than one percent] components are not listed or because of rounding errors.) According to the HDW, the S2SltCk solids have a weight percent composition of 26 percent sodium, 21 percent water, [illegible] percent nitrate, 15 percent hydroxide (total), 10 percent nitrite, 4 percent aluminum, 3 percent sulfate, 2 percent carbonate, 2 percent phosphate, and 1 percent TOC. The S2SltCk radionuclides consist primarily of ^{90}Sr and ^{137}Cs. The HDW model Z Plant waste consists primarily of

38 percent hydroxide (total), 29 percent water, 17 percent aluminum, 5 percent nitrate, 5 percent iron, 3 percent sodium, 2 percent carbonate, and 1 percent calcium. Radionuclides contributed by the Z Plant waste are primarily plutonium and americium. The HDW model DW is composed mainly of 53 percent water, 17 percent hydroxide (total), 15 percent iron, 4 percent carbonate, 3 percent chromium, 3 percent sulfate, 2 percent sodium, 2 percent nickel, and 2 percent calcium. The HDW model lists no radionuclides for DW.

Agnew et al. (1997a) also predicted the supernatant composition for tank 241-SY-102 as of March 31, 1994. The estimated supernatant volume as of that date was 2,560 kL (676 kgal), and consisted primarily of 381 kL (101 kgal) of Z Plant supernatant and 1,200 kL (317 kgal) of T Plant DW supernatant, with the balance being water. However, since the March 31, 1994, reference date for this estimate, 1,630 kL (430 kgal) of supernatant was cross-site transferred from tank 241-SY-102 to tank 241-AP-104; after this transfer, approximately 662 kL (175 kgal) of supernatant remained in tank 241-SY-102. From August 1995 through September 1997, tank 241-SY-102 received approximately 1,160 kL (306 kgal) of salt well liquid from 200 West Area single-shell tanks and approximately 246 kL (65 kgal) of process water (Koreski 1998). Therefore, the supernatant waste in tank 241-SY-102 likely consists of a combination of Z Plant, T Plant, and single-shell tank salt well liquid wastes.

D3.3 EVALUATION OF TANK WASTE VOLUME

This section evaluates the volumes of solids and supernatant in the tank; these volumes will subsequently be used to determine the best-basis analyte inventories in the solid and supernatant phases. Section D3.3.1 discusses the sludge volume estimate, and Section D3.3.2 evaluates the supernatant volume estimate.

D3.3.1 Sludge Volume Estimate

The previous best-basis analysis (DiCenso et al. 1997) and Hanlon (1998b) estimate the sludge volume in tank 241-SY-102 at 330 kL (88 kgal). Appendix E of Hanlon (1998a) estimated the sludge volume of 270 kL (71 kgal) based on a May 12, 1987 sludge level measurement. Data presented in the remainder of this section support the 270-kL estimate for the sludge volume in tank 241-SY-102. The 60-kL difference between the 330-kL and 270-kL estimates may be caused by settling and compaction of the sludge with time but may just as easily be attributed to assumptions and uncertainties in estimating the sludge depth.

Data available for estimating the sludge depth in tank 241-SY-012 include sludge weight measurements, core sample extrusion data, and grab sample information.

Table D3-1 summarizes estimates of the sludge layer depths based on sludge weight measurements. The average sludge depth based on the data in this table is 55.8 cm (22 in.),

with an equivalent sludge volume of 229 kL (60.4 kgal). Omitted from the table is the July 8, 1997 sludge depth estimate of 18 cm (7.1 in.) from riser 23A (LMHC 1997b); this depth is obviously at odds with the sludge length recovered from the July 1997 core sample taken from the same riser. These sludge-weight measurements may be biased low. Observations of extruded core segments indicate that the top layer of the sludge appears to be quite fluid (see Appendix B). If this layer is sufficiently fluid, then the sludge weight may penetrate the sludge layer somewhat before meeting sufficient resistance for the weight line to go slack.

Table D3-1. Tank 241-SY-102 Sludge Level Estimates by the Sludge Weight Method.

Riser No.	Date	Estimated Sludge Depth		Reference
		cm	(in.)	
1C	1/30/87	53.3	(21.0)	Tank farm data sheets
1C	5/2/87	81.3	(32.0)	Tank farm data sheets
1C	9/1/87	53.3	(21.0)	Tank farm data sheets
Riser 1C Mean:		62.7	(24.7)	
2A	1995	69.9	(27.5)	Brown (1995)
17A	5/2/87	43.8	(17.3)	Tank farm data sheets
17C	1/30/87	45.7	(18.0)	Tank farm data sheets
17C	5/2/87	71.1	(28.0)	Tank farm data sheets
17C	9/1/87	36.8	(14.5)	Tank farm data sheets
17C	7/2/97	34.2	(13.5)	LMHC (1997b)
Riser 17C Mean:		47.0	(18.5)	
Depth Grand Mean[1]:		55.8	(22.0)	
Equivalent Sludge Volume:		229 kL	(60.4 kgal)	

Note:

[1]The grand mean is the average of the means from risers 1C and 17C, and the data from risers 2A and 17A.

Table D3-2 considers the lengths of extruded solids from three cores taken from tank 241-SY-102. The extruded lengths of solids from cores 16, 211, and 213 were similar, and these extruded solids lengths were used to support the sludge volume estimate. For cores 16 and 211, sludge was extruded from the two bottom core segments. This fact indicates that the sludge depth is clearly greater than one 48-cm (19-in.)-long segment under risers 13A and 23A. Therefore the sludge depths under these risers were estimated by adding the length of the extruded solids from the upper segment to 48 cm. The 48-cm length arises by assuming

that the bottom of the sampler is exactly 48 cm above the tank bottom when it samples the supernatant/sludge interface. The average sludge depth based on the core extrusion data is 61 cm (24 in.), with an equivalent sludge volume of 250 kL (66 kgal).

Estimates of the core depth based on the length of extruded solids will be biased low if the core sampler is not 100 percent efficient in capturing the available solids at the supernatant/ solids interface or if the sampler bottom is greater than 48 cm (19 in.) above the tank bottom when the interface is sampled.

Table D3-2 does not include data from core 17 of the 1990 core sampling effort because of concerns that core 17 did not represent the tank contents (Tingey and Sasaki 1995). The extruded lengths from the 1988 core sampling effort were also discounted because the reported extruded length included the supernatant portions of the segments.

Table D3-2. Tank 241-SY-102 Sludge Level Estimates from Extruded Core Segments.

Riser No.	Date	Core:Segment	Length Solids Extruded		Estimated Sludge Depth		Reference
			cm	(in.)	cm	(in.)	
13A	2/21/90	16:3	18	(7)	66	(26)	Tingey and Sasaki (1995)
17C	8/8/97	213:13	43	(17)	43	(17)	Steen (1998)
23A	7/28/97	211:11R	25	(10)	74	(29)	Steen (1998)
Mean Depth:					61	24	
Equivalent Sludge Volume:					250 kL	(66 kgal)	

Finally, depth information for the deepest grab sample from the January 14, 1997, grab sampling of tank 241-SY-102 provides a lower bound for the sludge layer under riser 1A. Sample 2SY-96-3 was taken at an elevation (from the bottom of the tank) of 43.2 cm (17.0 in.) (LMHC 1997a). Because this sample consisted primarily of sludge, the sludge depth under the sampled riser may be inferred to be at least 43 cm deep. This observation is consistent with the other sludge depth data. However, because the estimated depth represents a lower boundary for the sludge depth, it was not used to estimate the sludge volume.

The sludge volume estimate of 229 kL (60.4 kgal) based on the sludge weight measurements, the estimate of 250 kL (66 kgal) based on the extruded segment lengths, and the Hanlon (1998a) value of 270 kL (71 kgal), are very similar. Because the volume estimates based on the sludge weight and core extrusion data may be biased low, adopting the Hanlon (1998a) value of 270 kL provides a conservative estimate of the amount of sludge in tank 241-SY-102. The sludge volume estimate of 270 kL is also consistent with the estimate

of 268 kL (70.9 kgal) used in the HDW TLM inventory estimate for the sludge layer in tank 241-SY-102 (Agnew et al. 1997a). Therefore, the sludge volume estimate of 270 kL is adopted for the best-basis estimate for the sludge layer.

D3.3.2 Supernatant Volume Estimate

Tank 241-SY-102 is the only active tank in the 200 West Area. The tank routinely receives wastes from the 200 West Area operations and serves as the staging tank for cross-site transfers to the 200 East Area double-shell tank farms. This waste transfer activity causes two problems for determining the best-basis inventory for the supernatant portion of the tank: 1) the total supernatant volume changes frequently and 2) the chemical and radionuclide composition of the supernatant is subject to change.

Several possible supernatant volumes might be considered for performing the best-basis analysis. The HDW model used a supernatant volume of 2,560 kL (676 kgal) as of March 31, 1994 (Agnew et al. 1997a). A supernatant volume of 2,520 kL could be considered; this volume is derived by subtracting the sludge volume estimate of 270 kL from the total waste volume of 2,790 kL as of March 31, 1998 (Hanlon 1998b). However, a best-basis evaluation based on one of these volumes will become dated as soon as a significant quantity of supernatant is transferred to or from the tank.

Therefore, to minimize the effect of supernatant transfers to and from the tank, the bottom 1,080 kL (287 kgal) of supernatant was chosen for this best-basis inventory estimate. This volume reflects the current administrative *minimum* waste level of 330 cm (130 in.) allowed in tank 241-SY-102 (LMHC 1998b). A minimum level was established to avoid disturbing the sludge layer on the bottom of tank 241-SY-102 during cross-site waste transfers from the tank. The level of 330 cm corresponds to 1,350 kL (358 kgal) of total waste volume in the tank or approximately one-third of the total tank capacity. Subtracting the estimated sludge volume of 270 kL (see Section 3.3.1) from 1,350 kL leaves 1,080 kL. The 1,080 kL volume is assumed to be a "static" portion of the tank supernatant and is the volume chosen to generate the best-basis inventory estimate for the supernatant. Minimal mixing is assumed to occur between the static supernatant layer and the excluded supernatant layer; Section D3.4 explores this assumption in more detail.

Performing the best-basis inventory evaluation on the bottom 1,080 kL of supernatant excludes the upper 1,440 kL (379 kgal) of supernatant in tank 241-SY-102 from the best-basis evaluation. The excluded volume of 1,440 kL is based on the Hanlon (1998b) total waste volume estimate of 2,790 kL (737 kgal) as of March 31, 1998, and the sludge volume estimate of 270 kL (71 kgal). Subtracting the sludge volume of 270 kL from the total waste volume of 2,790 kL yields a total supernatant volume of 2,520 kL (666 kgal). Subtracting the bottom 1,080 kL supernatant volume from 2,520 kL yields an excluded supernatant volume of 1,440 kL.

In summary, this best-basis analysis does not intend to generate an inventory for the variable portion of the tank supernatant, but only for that 1,080-kL portion that, because of the tank's administrative minimum waste level, may be reasonably considered constant. Should the need arise to estimate the inventory in the excluded portion of the supernatant, waste volume estimates (Hanlon 1998b) and grab sample data (see Appendix B) are available for such estimates. More recent analytical data from the March 1998 grab sampling of the tank were not available in time to be included in this TCR.

D3.4 ASSUMPTIONS USED

An engineering evaluation based on tank 241-SY-102 sample results was conducted to predict the static portion of the tank contents. The engineering evaluation assumes the following:

- The waste volumes are 270 kL (71 kgal) of solids and 1,080 kL (287 kgal) of supernatant for a total waste volume of 1,350 kL (358 kgal) (see Section D3.3). Hanlon (1998b) estimates the sludge volume at 330 kL (88 kgal) and the tank supernatant at 2,460 kL (649 kgal) as of March 31, 1998.

- The solids density is 1.44 g/mL; this value is the mean value for the July/ August 1997 push mode core samples (see Appendix B, Table B2-120).

- For those best-basis analytes in the sludge with no sample-based data, the HDW TLM concentration data are assumed valid.

- The "static" 1,080-kL (287-kgal) portion of the supernatant is assumed to be represented by January 1997 grab sample 2SY-96-2. This sample was taken at an elevation (from the tank bottom) of 243 cm (96 in.); this elevation is approximately 87 cm (34 in.) below the "surface" of the static layer at elevation 330 cm (130 in.).

- The specific gravity of the supernatant is 1.08; this is the mean value for sample 2SY-96-2 (see Table B2-64).

- The static supernatant volume is assumed not to mix with the upper layers of supernatant. This assumption should be valid to a certain extent because the specific gravity data for the supernatant samples do not indicate any extreme density gradients in the supernatant waste. Furthermore, the heat-generating radionuclide content in the tank is sufficiently small that thermal convection in the supernatant is likely to be minimal. Some mixing will occur from mechanical agitation when supernatant is added to the tank. However, because of the layers of supernatant between the static supernatant layer and the surface of the supernatant, such additions are not likely to affect the static supernatant layer.

- For those best-basis analytes in the supernatant with no sample-based data, the HDW SMM concentration data are assumed to model the chemical and radiochemical composition of the supernatant volume. For certain analytes with sample-based values that are less than detectable (bismuth, iron, lanthanum, nickel, lead, strontium, and zirconium) the best-basis supernatant concentrations are set to zero because of the low detection limits for these analytes, the highly insoluble nature of these metal species, and from process knowledge that these species are not likely present in significant quantity.

- Mercury inventories for the sludge and supernatant layers are assumed zero (Simpson 1998).

- All radionuclide data are corrected to January 1, 1994.

Assuming the validity of the SMM, the composition estimate for the supernatant in tank 241-SY-102 must be examined in more detail. The effective date for the SMM composition is March 31, 1994. The estimated supernatant volume as of that date was 2,560 kL (676 kgal) and consisted primarily of 381 kL (101 kgal) of Z Plant supernatant and 1,200 kL (317 kgal) of T Plant DW supernatant, with the balance being water. Since the March 31, 1994, reference date for this estimate, 1,630 kL (430 kgal) of supernatant were cross-site transferred from tank 241-SY-102 to tank 241-AP-104; after this transfer, approximately 662 kL (175 kgal) of supernatant remained in tank 241-SY-102. From August 1995 through September 1997, tank 241-SY-102 received approximately 1,160 kL (306 kgal) of salt well liquid from 200 West Area single-shell tanks and approximately 246 kL (65 kgal) of process water (Koreski 1998). Therefore, the supernatant waste in tank 241-SY-102 likely consists of a combination of Z Plant, T Plant, and single-shell tank salt well liquid wastes.

The conclusion is that the Agnew et al. (1997a) SMM estimate for the current composition of the supernatant in tank 241-SY-102 is probably poor. However, because sample-based data exist for the major chemical and radionuclide components in the supernatant, assuming the SMM is valid (when it may not be) will affect only the minor constituents. Furthermore, an attempt to model the composition of the single-shell tank salt well liquid added to the tank using, for example, linear combinations of HDW supernatant models, is beyond the scope of this report.

D3.5 BASIS FOR CALCULATIONS USED IN THIS ENGINEERING EVALUATION

Section D3.5.1 discusses the calculations used for the engineering evaluation for the sludge layer in tank 241-SY-102; Section D3.5.2 does the same for the 1,080-kL (287-kgal) static supernatant volume in the tank. Table D3-3 summarizes the engineering evaluation approach.

Table D3-3. Engineering Evaluation Approach Used for Tank 241-SY-102.

Type of Waste	How Calculated	Check Method
Sludge	Multiplied 1997 push mode core sample-based solids mean concentrations (see Table B3-9) by an average density of 1.44 g/mL and solids volume of 270 kL (71 kgal).	Mass balance; compared concentrations to 1990 push mode core sample results and to HDW TLM.
Supernatant	Multiplied supernatant sample 2SY-96-2 concentrations (see Tables B2-17 through B2-73) by 1,080 kL (358 kgal).	Mass balance

D3.5.1 Sludge Inventory Estimate

The tank 241-SY-102 sludge inventory estimate is based, in order of consideration, on three sources of information: 1) the July/August 1997 push mode core samples, 2) the February/ March 1990 push mode core samples, and 3) the HDW tank layer model (TLM) values (Agnew et al. 1997a). Table B3-9, Appendix B, of this TCR contains the mean concentration values for the July/August 1997 core samples. Tables B2-167 through B2-172, Appendix B, present the data from the February/March 1990 core samples; these data are further discussed in Section B3.3.2.1.

The 1997 core sample data were considered the most reliable source of sample-based data for the sludge inventory estimates. For those best-basis analytes with no 1997 core data, data from the 1990 core samples were used. For those best-basis analytes with no sample-based data, TLM data were used. Of the sample-based data, the 1997 core data were considered more reliable than the 1990 core data for four reasons: 1) the 1997 data are more recent; 2) the quality control for the 1997 data was more rigorous; 3) the 1997 samples were from two risers, and the 1990 samples were from only one riser; and 4) because the 1990 samples were centrifuged before analysis, assumptions were required to recover an estimate of the uncentrifuged sludge concentrations. Of the 1990 core data, the core 16 data were considered more reliable than the core 17 data because of concerns about how well the core 17 samples represented the sludge layer (Tingey and Sasaki 1995). Therefore, core 17 data were used only when no core 16 data were available. For many analytes, the 1997 and 1990 core data are in reasonable agreement.

D3.5.1.1 February/March 1990 Core Sludge Analyte Concentration Estimates. Tingey and Sasaki (1995) describe the sample treatment and analysis of the February/March 1990 core samples. The sludge samples were centrifuged before analysis, and the resulting centrifuged solids and liquids were analyzed separately. However, Tingey and Sasaki (1995) do not report the resulting mass fractions and densities of the centrifuged fractions required to mathematically "reconstitute" the analyte concentrations in the original, uncentrifuged, sludge.

The following equation was used to calculate the analyte concentration in the original sample from the analyte concentrations determined in the centrifuged fractions:

$$[A]_T(\mu g/g) = mf_{CS}[A]_{CS}(\mu g/g) + (1 - mf_{CS})[A]_{CL}(\mu g/mL)\frac{1}{SpG_{CL}}(mL/g) \qquad \text{Eq. D3-1}$$

where $[A]_T$ is the total concentration of analyte "A" in the uncentrifuged sludge, mf_{CS} is the mass fraction of the centrifuged solids in the centrifuge sample (= mass of centrifuged solid fraction divided by the total mass of the centrifuged sample), $[A]_{CS}$ is the concentration of A in the centrifuged solid fraction, $[A]_{CL}$ is the concentration of A in the centrifuged liquid fraction, and SpG_{CL} is the specific gravity of the centrifuged liquid fraction. The specific gravity is assumed to be equal to the density of the centrifuged liquid fraction. The equation is also valid for the radionuclides by substituting μCi for μg.

Because Tingey and Sasaki (1995) do not report values for mf_{CS} or SpG_{CL} for use in Equation D3-1, these quantities were estimated as follows. Scheele and Peterson (1990) report values for mf_{CS} for core solids obtained during the October 1988 push mode core sampling of tank 241-SY-102 through riser 1B. Reported values of mf_{CS} are 0.939 for sample 102-SY-4B and 0.602 for sample 102-SY-T4C. Sample 102-SY-4B was the bottom portion of segment 4; because segment 4 consisted of 38 cm (15 in.) of solids, sample 102-SY-4B was assumed to represent the bottom 19 cm (7.5 in.) of the sludge in tank 241-SY-102. Sample 102-SY-T4C was assumed to represent the upper sludge layers. Herting (1994) reports additional values for mf_{CS} of 0.60 and 0.61 for two sludge samples obtained by grab sampling on March 10, 1994. These two values of mf_{CS} agree closely with that reported for 1988 core sample 102-SY-T4C. Therefore, a value of 0.605 was chosen as the value of mf_{CS} for the upper portions of the sludge layer in tank 241-SY-102. A weighted value for mf_{CS} was calculated for the entire sludge layer:

$$\text{weighted } mf_{CS} = (19.1 \text{ cm}/65.6 \text{ cm})0.939 + (1 - 19.1 \text{ cm}/65.6 \text{ cm})0.605 = 0.702 \qquad \text{Eq. D3-2}$$

where 19.1 cm is the length of sludge represented by mf_{CS} = 0.939 and 65.6 cm is the depth of the sludge layer of a 270-kL (71-kgal) volume.

The value for SpG_{CL} in Equation D3-1 was estimated as 1.15; this is the mean value of the specific gravity for the drainable liquids from the 1997 core samples (see Appendix B, Table B3-10).

With estimates for mf_{CS} and SpG_{CL} available, Equation D3-1 was used to calculate the analyte concentrations in the original, uncentrifuged sludge. Core 16 data were used to compute the majority of the analytes; core 17 data were used for those analytes (mostly radionuclides) not determined for core 16. For the ICP/AES solid fraction data, values from the sodium peroxide/zirconium crucible and potassium hydroxide/nickel crucible sample preparations were averaged together with the exceptions of nickel, potassium, sodium, and zirconium. For the ICP/AES liquid fraction data, the "1x" dilution values only were used with the exception of the "10x" value used for sodium; "1x" and "10x" values were not averaged together. Most of the remaining 1990 core data are single measurements, not mean values. Total inorganic carbon, TOC, and ^{14}C were the only analytes for which sample and duplicate determinations were performed (the mean values of which were used in Equation D3-1). These three analytes were determined in duplicate for both the solid and liquid fractions of the centrifuged sludge.

Tables D3-4 and D3-5 compare the nonradioactive and radioactive analyte concentrations for the sludge layer as determined from the 1990 core samples, the 1997 core samples, and the TLM. The 1990 values shown in these two tables were computed from the centrifuged solid and liquid fractions as discussed earlier in this section. The radionuclide activities for the 1990 and 1997 core samples were decay corrected to the common date of January 1, 1994, for comparison with the TLM values. The 1990 and 1997 core sample data sets have results for several non-best-basis analytes, and Tables D3-4 and D3-5 also list these non-best-basis analyte results.

Table D3-4. Comparison of Sample-Based and TLM Analyte Concentrations for Tank 241-SY-102 Sludge: Nonradioactive Components. (3 sheets)

Analyte	1990 Core Computed Value[1]		1997 Core Mean Value[2]	TLM Value[3]
	Sample ID[4]	µg/g	µg/g	µg/g
ICP/AES Analytes				
Aluminum	16:comp	27,300	33,600	81,100
Antimony	16:comp	<211	<18.0	n/r
Arsenic	16:comp	<504	<30.0	n/r
Barium	16:comp	66.6	29.5	n/r
Beryllium	16:comp	2.83	2.66	n/r
Bismuth	n/r	n/r	1,280	382
Boron	16:comp	<191	128	n/r
Cadmium	16:comp	247	182	n/r
Calcium	16:comp	5,120	1,980	4,790
Cerium	16:comp	<531	75.9	n/r
Chromium	16:comp	13,800	12,400	3,860
Cobalt	16:comp	<1,040	8.26	n/r

Table D3-4. Comparison of Sample-Based and TLM Analyte Concentrations for Tank 241-SY-102 Sludge: Nonradioactive Components. (3 sheets)

Analyte	1990 Core Computed Value[1]		1997 Core Mean Value[2]	TLM Value[3]
	Sample ID[4]	µg/g	µg/g	µg/g
Copper	16:comp	291	27.2	n/r
Dysprosium	16:comp	<23.2	n/r	n/r
Iron	16:comp	14,500	13,200	26,500
Lanthanum	16:comp	72.4	81.1	0.746
Lead	16:comp	1,110	1,010	145
Magnesium	16:comp	<702	579	n/r
Manganese	16:comp	3,790	4,400	41.5
Molybdenum	16:comp	<53.1	24.7	n/r
Neodymium	16:comp	<206	113	n/r
Nickel	16:comp	665	190	2,050
Phosphorus	16:comp	31,500	9,100	n/r
Potassium	16:comp	2,890	1,380	1,670
Rhenium	16:comp	<44.0	n/r	n/r
Rhodium	16:comp	<246	n/r	n/r
Ruthenium	16:comp	<163	n/r	n/r
Samarium	n/r	n/r	<31.5	n/r
Selenium	16:comp	<482	<31.5	n/r
Silicon	16:comp	5,110	1,240	661
Silver	16:comp	110	96.7	n/r
Sodium	16:comp	1.45E+05	79,600	1.72E+05
Strontium	16:comp	75.9	57.3	0.00
Sulfur	n/r	n/r	1,160	n/r
Tellurium	16:comp	<218	n/r	n/r
Thallium	16:comp	<4,280	<59.9	n/r
Thorium	16:comp	1,410	n/r	n/r
Titanium	16:comp	126	30.4	n/r
Uranium	16:comp	<4,050	1,280	577
Vanadium	16:comp	50.4	<15.0	n/r
Zinc	16:comp	<855	353	n/r
Zirconium	16:comp	208	75.2	18.6

Table D3-4. Comparison of Sample-Based and TLM Analyte Concentrations for Tank 241-SY-102 Sludge: Nonradioactive Components. (3 sheets)

Analyte	1990 Core Computed Value[1]		1997 Core Mean Value[2]	TLM Value[3]
	Sample ID[4]	μg/g	μg/g	μg/g
Ion-Chromatography Analytes				
Chloride	16:comp	988	2,460	1,840
Fluoride	16:comp	4,070	1,700	730
Nitrate	16:comp	74,200	1.06E+05	1.21E+05
Nitrite	16:comp	11,200	32,800	60,800
Oxalate	n/r	n/r	28,100	0.619
Phosphate	16:comp	41,100	30,400	10,200
Sulfate	16:comp	4,330	5,630	20,000
Miscellaneous Analytes				
Chromium (VI)	16:comp	875	n/r	n/r
Hydroxide	n/r	n/r	n/r	2.29E+05
Mercury	n/r	n/r	n/r	1.55
TIC[5] (μg C/g)	16:comp	5,560	n/r	4,280
TOC (μg C/g)	16:comp	5,370	n/r	8,200
Uranium (total)	16:comp	1,750 [6]	1,420 [7]	577
Weight percent water (wt%)	n/r	n/r	58.2	25.5
Bulk density[8] (g/mL)	17:3R, 4	1.45	1.44	1.84

Notes:

[1]Computed from the values listed in Appendix B, Tables B2-163 through B2-166, and using Equation D3-1 with a solids mass fraction value of 0.702 and a centrifuged liquid specific gravity of 1.15.

[2]From Appendix B Table B3-9.

[3]Agnew et al. (1997a)

[4]Sample identifiers: 16:comp = core 16 composite; 17:3R, 4 = core 17, segments 3R and 4

[5]The TLM carbonate value of 21,400 μg/g carbonate was converted to the TIC basis for comparison with the sample-based data.

[6]Total uranium by fluorescence.

[7]Sum of ICP/MS values for ^{235}U and ^{238}U.

[8]The sample-based bulk densities are mean values: the 1990 value is the mean of the values found in Appendix B Table B2-162; the 1997 value is the mean of the values found in Appendix B Table B2-120.

Table D3-5. Comparison of Sample-Based and TLM Analyte Concentrations for Tank 241-SY-102 Sludge: Radioactive Components Decay Corrected to January 1, 1994. (2 sheets)

Analyte	1990 Core Computed Value[1]		1997 Core Mean Value[2]	TLM Value[3]
	Sample ID[4]	μCi/g	μCi/g	μCi/g
Total alpha activity[5]	16:comp	22.4	28.4	n/r
Total beta activity[5]	16:comp	264	n/r	n/r
^{3}H	16:comp	6.96E-04	n/r	0.150
^{14}C	16:comp	0.00316	n/r	0.0194
^{60}Co	16:comp	0.129	n/r	0.0139
^{79}Se	16:comp	<0.0155	n/r	0.00123
^{90}Sr	16:comp	89.6	n/r	24.3
^{99}Tc	16:comp	0.0610	n/r	0.172
^{106}Ru	17:3/4 comp	<0.183	n/r	2.33E-06
^{125}Sb	17:3/4 comp	<0.489	n/r	0.0609
^{134}Cs	16:comp	<0.0453	n/r	0.00178
^{137}Cs	16:comp	27.7	n/r	187
^{152}Eu	17:3/4 comp	<0.345	n/r	0.00150
^{154}Eu	17:3/4 comp	1.38	n/r	0.218
^{155}Eu	17:3/4 comp	1.25	n/r	0.0891
^{229}Th	n/r	n/r	<0.0176[6]	9.52E-07
^{232}Th	n/r	n/r	4.65E-05[6]	4.33E-06
^{233}U	n/r	n/r	0.00832[6]	3.63E-04
^{234}U	n/r	n/r	<0.00133[6]	2.03E-04
^{235}U	n/r	n/r	2.59E-05[6]	8.51E-06
^{236}U	n/r	n/r	2.90E-05[6]	4.89E-06
^{237}Np	16:comp	<0.00176	0.00109[6]	6.29E-04
^{238}U	16:comp	5.88E-04[7]	4.74E-04[6]	1.93E-04[8]
^{238}Pu	16:comp	0.782	n/r	3.06E-04
$^{239/240}Pu$[5]	16:comp	7.09	8.35	n/r
^{239}Pu	n/r	n/r	4.29[6]	5.34
^{240}Pu	n/r	n/r	1.64[6]	1.33
$^{241}Pu/^{241}Am$[5] (μg/g)	n/r	n/r	6.55	n/r

Table D3-5. Comparison of Sample-Based and TLM Analyte Concentrations for Tank 241-SY-102 Sludge: Radioactive Components Decay Corrected to January 1, 1994. (2 sheets)

Analyte	1990 Core Computed Value[1]		1997 Core Mean Value[2]	TLM Value[3]
	Sample ID[4]	μCi/g	μCi/g	μCi/g
^{241}Am	16:comp	25.0	29.9	5.63
^{242}Pu	n/r	n/r	6.92E-04[6]	1.11E-07
$^{243}Am/^{243}Cm$[5] (μg/g)	n/r	n/r	<0.0853	n/r
$^{243/244}Cm$[5]	16:comp	0.0667	n/r	n/r
$^{244}Pu/^{244}Cm$[5] (μg/g)	n/r	n/r	<0.0458	n/r

Notes:

[1]Computed from the values listed in Appendix B, Table B2-167 and using Equation D3-1 with a solids mass fraction value of 0.702 and a centrifuged liquid specific gravity of 1.15. The GEA analytes ^{60}Co, ^{106}Ru, ^{125}Sb, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, and ^{155}Eu were decay corrected from January 1, 1990 to January 1, 1994. The remaining radionuclides were decay corrected from January 1, 1991 to January 1, 1994.

[2]From Appendix B, Table B3-9, and decay corrected from October 15, 1997 to January 1, 1994.

[3]Agnew et al. (1997a)

[4]Sample identifiers: 16:comp = core 16 composite; 17:3/4 comp = core 17, segments 3R and 4 composite.

[5]Mixed radionuclides are not decay corrected; these data may be used to bound or calculate activity estimates for individual radionuclides.

[6]Converted from ICP/MS values in μg/g to μCi/g using specific activities from Kirkpatrick and Brown (1984)

[7]Estimated from total uranium by fluorescence and assuming ^{238}U is the major contributor to the total uranium value.

[8]The ^{238}U activity of 1.93E-04 μCi/g given here differs from the value of 2.50E-04 μCi/g listed in Agnew et al. (1997a). The value of 2.50E-04 μCi/g is incorrect; the value of 1.93E-04 μCi/g was computed from the Agnew et al. (1997a) value of 577 μg/g total uranium minus the mass contributed from ^{235}U.

In general, the results from the 1990 and 1997 core samples are in reasonable agreement. However, the values for the following analytes with a concentration ≥1,000 μg/g differ by at least a factor of two: calcium, phosphorus, silicon, chloride, fluoride, and nitrite. Differences in the results may arise from four causes: 1) "random" (i.e., not statistically significant) fluctuations in the sampling and measurements, 2) differences caused by mis-estimating the values of mf_{CS} and SpG_{CL} for the 1990 core data, 3) real differences caused

by the sampling and measurement process (e.g., background contamination from the sampling and preparation steps), and 4) real differences in the original sludge. Real differences in the sludge may arise from variations in the chemical composition of the sludge as a function of either sample location or sample date. However, without a rigorous statistical analysis, the statistical significance of any of these differences is not known.

D3.5.1.2 Calculation of Sludge Inventory Estimates. Using the data from Tables D3-4 and D3-5, the sludge inventory estimates were calculated for the best-basis analytes. Tables D3-6 and D3-7 show the estimated inventories for the nonradioactive and radioactive best-basis analytes in the sludge layer. Sample-based analyte concentrations from both the 1990 and 1997 core samples were used, as well as TLM-predicted concentrations for those analytes with no sample-based data. The sludge inventory values were generated using the following logic and assumptions.

- Sample-based data were used in preference to the TLM-based data. The 1997 core data were used in preference to the 1990 core data. The 1990 core value was adopted if no 1997 core value was available for the analyte, or if the 1997 core value was a less-than value and the 1990 core value was not a less-than value. The TLM value was adopted if no sample-based data existed. The "Best-Basis Value" column in Tables D3-6 and D3-7 indicates the value selected for generating the best-basis inventory value.

- Sample-based less-than values were treated as follows. If the TLM value was less than the sample-based less-than value, then the TLM value was adopted. If the TLM value was greater than the sample-based less-than value, then the sample-based value was adopted after dropping the less-than sign.

- The 1997 core sample mean bulk density for the solids of 1.44 g/mL and the sludge volume of 270 kL (71 kgal) was used for computing the best-basis analyte inventories.

- The 1997 core sample mean oxalate value of 28,100 μg/g was converted to its corresponding carbon concentration of 7,670 μg C/g; this value was used as the estimate for the TOC concentration in the sludge layer.

- The total hydroxide inventory value was determined by charge balance after estimating all the other best-basis analyte inventories. For the charge balance, the non-hydroxide anions were assumed to be CO_3^{2-}, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, SiO_3^-, and TOC as oxalate. Assumed metal oxidation states were Cr(III), Mn(IV), U(VI), and Zr(IV). This charge balance approach is consistent with that used by Agnew et al. (1997a).

Oxalate was assumed to be a fair representation of the TOC in the sludge because no DSC exotherms were observed in the sludge. The absence of such exotherms indicates that what organic carbon exists in the waste must be in a low-energy form such as oxalate.

For the nonradioactive best-basis analytes in the sludge layer, the values in the "Inventory Estimate" column of Table D3-6 were computed using Equation D3-3:

$$A_{solids}\ (kg) = [A]_S\ (\mu g/g) \times d_S\ (g/mL) \times 0.001\ (mL/\mu L) \times V_S\ (kL) \qquad \text{Eq. D3-3}$$

where A_{solids} is the inventory in kg of analyte "A" in the solids layer, $[A]_S$ is the concentration of analyte A in the solids layer from the "Best-Basis Value" column in Table D3-6, d_S is the mean density of the solids layer (1.44 g/mL), and V_S is the solids volume (270 kL [71 kgal]).

For the radioactive best-basis analytes in the sludge layer, the values in the "Inventory Estimate" column of Table D3-7 were computed using Equation D3-4:

$$A_{solids}\ (Ci) = [A]_S\ (\mu Ci/g) \times d_S\ (g/mL) \times V_S\ (kL) \qquad \text{Eq. D3-4}$$

where A_{solids} is the inventory in Ci of analyte "A" in the solids layer, $[A]_S$ is the activity of analyte A in the solids layer from the "Best-Basis Value" column in Table D3-7, d_S is the mean density of the solids layer (1.44 g/mL), and V_S is the solids volume (270 kL [71 kgal]).

D3.5.1.3 Sludge Radionuclide Inventory Estimates: Additional Calculations Some of the radionuclide best-basis estimates shown in Table D3-7 were derived from a combination of sample-based and model data. Those estimates were calculated using the methods in this section.

- The ^{90}Y value was assumed equal to the ^{90}Sr value.
- The ^{137m}Ba value was assumed equal to 0.946 times the ^{137}Cs value.
- In the absence of sample-based data, activities and inventories of uranium isotopes were calculated from the sample-based estimate for ^{238}U and uranium isotopic ratios from the TLM:

$$^{23X}U_{estimate}\ (Ci) = (^{23X}U_{TLM} / {}^{238}U_{TLM}) \times {}^{238}U_{sample} \qquad \text{Eq. D3-5}$$

where $^{23X}U_{estimate}$ is the uranium isotope of interest, $^{23X}U_{TLM}$ is the TLM estimate for the isotope's activity, $^{238}U_{TLM}$ is the TLM estimate for ^{238}U activity, and $^{238}U_{sample}$ is the sample-based estimate for the ^{238}U activity. The TLM ^{238}U activity of 2.50E-04 μCi/g listed in Agnew et al. (1997a) is incorrect. The correct value is 1.93E-04 μCi/g and was computed from the Agnew et al. (1997a) value of 577 μg/g total uranium minus the mass contributed from ^{235}U.

- Activities and inventories of plutonium isotopes may be calculated from the sample-based estimate for $^{239/240}Pu$ and plutonium isotopic ratios from either the TLM or ICP/MS determinations. For sample-based values of $^{239/240}Pu$, the individual ^{239}Pu and ^{240}Pu activities may be calculated as:

$$^{239}Pu_{estimate}\ (Ci) = {}^{239/240}Pu_{sample} \times (^{239}Pu\ /\ (^{239}Pu + {}^{240}Pu))$$

$$^{240}Pu_{estimate}\ (Ci) = {}^{239/240}Pu_{sample} - {}^{239}Pu_{estimate} \qquad \text{Eq. D3-6}$$

where $^{239}Pu_{estimate}$ and $^{240}Pu_{estimate}$ are the estimated activities of the individual plutonium isotopes, $^{239/240}Pu_{sample}$ is the combined $^{239/240}Pu$ activity determined for the sample, and ^{239}Pu and ^{240}Pu are estimates for the plutonium isotope activities derived either from the TLM or from ICP/MS measurements.

Given the ^{239}Pu activity for a sample, the other plutonium isotopes may be estimated using Equation D3-7:

$$^{2XX}Pu_{estimate}\ (Ci) = (^{2XX}Pu_{TLM}\ /\ ^{239}Pu_{TLM}) \times {}^{239}Pu_{sample} \qquad \text{Eq. D3-7}$$

where $^{2XX}Pu_{estimate}$ is the plutonium isotope of interest, $^{2XX}Pu_{TLM}$ is the TLM estimate for the isotope's activity, $^{239}Pu_{TLM}$ is the TLM estimate for ^{239}Pu activity, and $^{239}Pu_{sample}$ is the sample-based estimate for the ^{239}Pu activity.

- Activities and inventories of ^{243}Am were calculated by multiplying the sample-based estimate for ^{241}Am by the ratio $^{243}Am_{TLM}/^{241}Am_{TLM}$ in a manner analogous to Equation D3-7.

- Activities and inventories of ^{242}Cm were calculated by multiplying the sample-based estimate for ^{241}Am by the ratio $^{242}Cm_{TLM}/^{241}Am_{TLM}$ in a manner analogous to Equation D3-7.

- Given a sample-based value for combined $^{243/244}Cm$ activity, the ^{243}Cm value was estimated as 0.04 times the $^{243/244}Cm$ activity, and the ^{244}Cm value was estimated as 0.96 times the $^{243/244}Cm$ activity.

Table D3-6. Sludge Non-Radionuclide Inventory Estimate for Tank 241-SY-102. (2 sheets)

Analyte	1997 Core Value[1]	1990 Core Value[1]	TLM Value[1]	Best-Basis Value	Inventory Estimate[2]
	μg/g	μg/g	μg/g	μg/g	kg
Al	33,600	27,300	81,100	33,600	13,000
Bi	1,280	n/r	382	1,280	495
Ca	1,980	5,120	4,790	1,980	766
Cl	2,460	988	1,840	2,460	952
TIC as CO_3	n/r	27,800 [3]	21,400	27,800	10,800
Cr	12,400	13,800	3,860	12,400	4,800
F	1,700	4,070	730	1,700	658
Fe	13,200	14,500	26,500	13,200	5,110
Hg	n/r	n/r	1.55	0.00 [4]	0.00 [4]
K	1,380	2,890	1,670	1,380	534
La	81.1	72.4	0.746	81.1	31.4
Mn	4,400	3,790	41.5	4,400	1,700
Na	79,600	1.45E+05	1.72E+05	79,600	30,800
Ni	190	665	2,050	190	73.5
NO_2	32,800	11,200	60,800	32,800	12,700
NO_3	1.06E+05	74,200	1.21E+05	1.06E+05	41,000
OH_{Total}	n/r	n/r	2.29E+05	66,000 [5]	25,600 [5]
Pb	1,010	1,110	145	1,010	391
PO_4	30,400	41,100	10,200	30,400	11,800
Si	1,240	5,110	661	1,240	480
SO_4	5,630	4,330	20,000	5,630	2,180
Sr	57.3	75.9	0.00	57.3	22.2
TOC (μg C/g)	7,670 [6]	5,370	8,200	7,670	2,970
U_{total}	1,420	1,750	577	1,420	550
Zr	75.2	208	18.6	75.2	29.1

Table D3-6. Sludge Non-Radionuclide Inventory Estimate for Tank 241-SY-102. (2 sheets)

Analyte	1997 Core Value[1]	1990 Core Value[1]	TLM Value[1]	Best-Basis Value	Inventory Estimate[2]
	μg/g	μg/g	μg/g	μg/g	kg
Water (wt%)	58.2	n/r	25.5	58.2	2.25E+05
Bulk density (g/mL)	1.44	1.45	1.84	1.44	n/a

Notes:

[1]From Table D3-3.

[2]Based on a solids density of 1.44 g/mL and a solids volume of 270 kL; see text for calculations.

[3]The 1990 core sample carbonate value was calculated from the corresponding TIC value of 5,560 μg/g.

[4]Best-basis mercury value set to zero per Simpson (1998).

[5]Total hydroxide value determined from charge balance; see text for discussion.

[6]The 1997 core sample TOC value was calculated from the corresponding oxalate value of 28,100 μg/g.

Table D3-7. Sludge Radionuclide Inventory Estimate for Tank 241-SY-102: Decay Corrected to January 1, 1994. (3 sheets)

Analyte	1997 Core Value[1]	1990 Core Value[1]	TLM Value[1]	Best-Basis Value	Inventory Estimate[2]
	μCi/g	μCi/g	μCi/g	μCi/g	Ci
^{3}H	n/r	6.96E-04	0.150	6.96E-04	0.269
^{14}C	n/r	0.00316	0.0194	0.00316	1.22
^{59}Ni	n/r	n/r	3.32E-04	3.32E-04	0.128
^{60}Co	n/r	0.129	0.0139	0.129	50.0
^{63}Ni	n/r	n/r	0.0327	0.0327	12.7
^{79}Se	n/r	<0.0155	0.00123	0.00123	0.476
^{90}Sr	n/r	89.6	24.3	89.6	34,700
^{90}Y	n/r	n/r	24.3	89.6 [3]	34,700 [3]
^{93}Zr	n/r	n/r	0.00605	0.00605	2.34
^{93m}Nb	n/r	n/r	0.00442	0.00442	1.71
^{99}Tc	n/r	0.0610	0.172	0.0610	23.6
^{106}Ru	n/r	<0.183	2.33E-06	2.33E-06	9.02E-04
^{113m}Cd	n/r	n/r	0.0313	0.0313	12.1

Table D3-7. Sludge Radionuclide Inventory Estimate for Tank 241-SY-102: Decay Corrected to January 1, 1994. (3 sheets)

Analyte	1997 Core Value[1]	1990 Core Value[1]	TLM Value[1]	Best-Basis Value	Inventory Estimate[2]
	μCi/g	μCi/g	μCi/g	μCi/g	Ci
^{125}Sb	n/r	<0.489	0.0609	0.0609	23.6
^{126}Sn	n/r	n/r	0.00187	0.00187	0.724
^{129}I	n/r	n/r	3.33E-04	3.33E-04	0.129
^{134}Cs	n/r	<0.0453	0.00178	0.00178	0.689
^{137}Cs	n/r	27.7	187	27.7	10,700
^{137m}Ba	n/r	n/r	177	26.2 [4]	10,100 [4]
^{151}Sm	n/r	n/r	4.35	4.35	1,680
^{152}Eu	n/r	<0.345	0.00150	0.00150	0.581
^{154}Eu	n/r	1.38	0.218	1.38	536
^{155}Eu	n/r	1.25	0.0891	1.25	485
^{226}Ra	n/r	n/r	5.51E-08	5.51E-08	2.13E-05
^{227}Ac	n/r	n/r	3.39E-07	3.39E-07	1.31E-04
^{228}Ra	n/r	n/r	3.92E-05	3.92E-05	0.0152
^{229}Th	<0.0176	n/r	9.52E-07	9.52E-07	3.68E-04
^{231}Pa	n/r	n/r	1.52E-06	1.52E-06	5.88E-04
^{232}Th	4.65E-05 [5]	n/r	4.33E-06	4.65E-05	0.0180
^{232}U	n/r	n/r	9.45E-05	2.32E-04 [6]	0.0899 [6]
^{233}U	0.00832 [5]	n/r	3.63E-04	0.00832	3.22
^{234}U	<0.00133 [5]	n/r	2.03E-04	4.99E-04 [6]	0.193 [6]
^{235}U	2.59E-05 [5]	n/r	8.51E-06	2.59E-05	0.0100
^{236}U	2.90E-05 [5]	n/r	4.89E-06	2.90E-05	0.0112
^{237}Np	0.00109 [5]	<0.00176	6.29E-04	0.00109	0.420
^{238}U	4.74E-04 [5]	5.88E-04 [7]	1.93E-04	4.74E-04	0.183
^{238}Pu	n/r	0.782	3.06E-04	0.782	303
^{239}Pu	6.04 [8]	5.68 [6]	5.34	6.04	2,340
^{240}Pu	2.31 [8]	1.41 [6]	1.33	2.31	894
^{241}Pu	n/r	n/r	0.0205	0.0232 [6]	8.98 [6]
^{241}Am	29.9	25.0	5.63	29.9	11,600
^{242}Pu	6.92E-04 [5]	n/r	1.11E-07	6.92E-04	0.268

Table D3-7. Sludge Radionuclide Inventory Estimate for Tank 241-SY-102: Decay Corrected to January 1, 1994. (3 sheets)

Analyte	1997 Core Value[1]	1990 Core Value[1]	TLM Value[1]	Best-Basis Value	Inventory Estimate[2]
	μCi/g	μCi/g	μCi/g	μCi/g	Ci
^{242}Cm	n/r	n/r	1.24E-07	6.58E-07 [6]	2.55E-04 [6]
^{243}Am	n/r	n/r	1.36E-06	7.22E-06 [6]	0.00279 [6]
^{243}Cm	n/r	0.00248 [6]	2.53E-09	0.00248 [6]	0.960 [6]
^{244}Cm	n/r	0.0571 [6]	7.36E-08	0.0571 [6]	22.1 [6]

Notes:

[1]From Table D3-4.

[2]Based on a solids density of 1.44 g/mL and a solids volume of 270 kL; see text for calculations.

[3]The ^{90}Y activity estimated as one times the ^{90}Sr value.

[4]The ^{137m}Ba activity estimated as 0.946 times the ^{137}Cs value.

[5]Converted from ICP/MS values in μg/g to μCi/g using specific activities from Kirkpatrick and Brown (1984).

[6]These activity values were calculated using sample-based ^{238}U, ^{239}Pu, ^{241}Am, and $^{243/244}$Cm values and isotopic ratios from the TLM; see text for further discussion.

[7]Estimated from total uranium by fluorescence and assuming ^{238}U is the major contributor to the total uranium value.

[8]Computed from Equation D3-6 using the $^{239/240}$Pu alpha count mean result and the ^{239}Pu and ^{240}Pu ratios as determined by ICP/MS.

D3.5.1.4 Sludge Inventory Estimates: Mass Balance Check. The assumptions used in generating the sludge inventory estimates for the nonradioactive components shown in Table D3-6 may be checked by estimating the mass of the sludge layer in tank 241-SY-102 using two *independent* methods. The mass of the sludge may be estimated by: 1) multiplying the estimated volume of the sludge layer (270 kL) by the estimated sludge density (1.44 g/mL), and 2) summing the masses of the individual best-basis chemical components shown in Table D3-6. The summation performed in method 2 assumes the same chemical speciation as that assumed for the charge balance calculation discussed above in this section. Note that method 2 indeed generates a mass estimate independent of method 1; the sum of the inventory estimates for the individual best-basis components is *not* constrained by the total sludge volume because the total hydroxide inventory is constrained only by charge balance and not by the sludge volume.

The mass calculated by method 1 is 387 metric tons and by method 2 is 393 metric tons with a relative percent difference of 1.4 between the two methods. The agreement between the two methods gives additional confidence that the data, assumptions, and methods used to generate the best-basis values for the sludge are reasonable; and that no major analytes are missing from the best-basis analysis.

D3.5.2 Supernatant Inventory Estimates

To accommodate a best-basis inventory estimate for the supernatant, the assumptions discussed in Section D3.4 were used. Only the supernatant volume of 1,080 kL (287 kgal) below 330 cm (130 in.) tank elevation was considered (see Section D3.3.2). The January 1997 grab sample 2SY-96-2 was assumed to represent the supernatant, and the supernatant mixing model (SMM) concentrations for best-basis analytes were assumed valid (Agnew et al. 1997a).

D3.5.2.1 Calculation of Supernatant Inventory Estimates. Tables D3-8 and D3-9 show the estimated inventories for the nonradioactive and radioactive best-basis analytes in the 1,080-kL supernatant volume. Sample-based analyte concentrations from the January 1997 grab sample 2SY-96-2 were used, as well as SMM-predicted concentrations for those analytes with no sample-based data. The supernatant inventory values were generated using the following logic and additional assumptions.

- Sample-based data were used in preference to the SMM-based data. The SMM value was adopted if no sample-based data existed. The "Best-Basis Value" column in Tables D3-8 and D3-9 indicates the value selected for generating the best-basis inventory value.

- For the nonradionuclides, sample-based less-than values were treated as follows. Bismuth, iron, lanthanum, nickel, lead, strontium, and zirconium all yielded less-than values for sample 2SY-96-2. The best-basis supernatant concentrations for these metals were set to zero because of the low detection limits for these analytes, the highly insoluble nature of these metal species, and from process knowledge that these species are not likely present in significant quantity. For calcium, the analytical value was adopted after dropping the less-han sign; calcium is likely present in solution because calcium is a common contaminant in the chemical feedstocks used in facility processes.

- For the radionuclides (including uranium), sample-based less-than values were treated as follows. If the SMM value was less than the sample-based less-than value, then the SMM value was adopted. If the SMM value was greater than the sample-based less-than value, then the sample-based value was adopted after dropping the less-than sign.

- The total hydroxide inventory value was determined by charge balance after estimating all the other best-basis analyte inventories. For the charge balance, the non-hydroxide anions were assumed to be CO_3^{2-}, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, SiO_3^-, and TOC as acetate. Assumed metal oxidation states were Cr(III), Mn(IV), U(VI), and Zr(IV). This charge balance approach is consistent with that used by Agnew et al. (1997a).

For the nonradioactive best-basis analytes in the supernatant layer, the values in "Inventory Estimate" column of Table D3-8 were computed using Equation D3-8:

$$A_{liquid}\ (kg) = [A]_L\ (\mu g/mL) \times 0.001\ (mL/\mu L) \times V_L\ (kL) \qquad \text{Eq. D3-8}$$

where A_{liquid} is the inventory in kg of analyte "A" in the liquid supernatant layer, $[A]_L$ is the concentration of analyte A in the liquid layer from the "Best-Basis Value" column in Table D3-8, and V_L is the static supernatant volume (1,080 kL).

For the radioactive best-basis analytes in the supernatant layer, the values in the "Inventory Estimate" column of Table D3-9 were computed using Equation D3-9:

$$A_{liquid}\ (Ci) = [A]_L\ (\mu Ci/mL) \times V_L\ (kL) \qquad \text{Eq. D3-9}$$

where A_{liquid} is the inventory in Ci of analyte "A" in the liquid supernatant layer, $[A]_L$ is the activity of analyte A in the liquid layer from the "Best-Basis Value" column in Table D3-9, and V_L is the supernatant volume (1,080 kL).

Some of the radionuclide best-basis estimates shown in Table D3-9 were derived from a combination of sample-based and model data. Those estimates were calculated using the methods outlined in Section D3.5.1.3.

Table D3-8. Supernatant Non-Radionuclide Inventory Estimate for Tank 241-SY-102. (2 sheets)

Analyte	Supernatant Analytical Value[1]	HDW SMM Value[2]	Best-Basis Value	Inventory Estimate[3]
	µg/mL	µg/mL	µg/mL	kg
Al	5,110	1,030	5,110	5,540
Bi	<20.1	0.0771	0.00 [4]	0.00 [4]
Ca	<20.1	225	20.1	21.8
Cl	1,120	533	1,120	1,210
TIC as CO_3	7,490	1,790	7,490	8,130
Cr	943	272	943	1,020
F	597	0.437	597	647
Fe	<10.1	69.5	0.00 [4]	0.00 [4]
Hg	n/r	5.60E-04	0.00 [5]	0.00 [5]
K	2,100	88.4	2,100	2,280
La	<10.1	5.28E-04	0.00 [4]	0.00 [4]
Mn	<2.01	0.194	0.00 [4]	0.00 [4]
Na	46,900	14,500	46,900	50,900
Ni	<4.02	65.7	0.00 [4]	0.00 [4]
NO_2	14,500	647	14,500	15,700
NO_3	48,200	28,700	48,200	52,300
OH_{Total}	7,880	3,780	18,700 [6]	20,300 [6]
Pb	<20.1	0.0725	0.00 [4]	0.00 [4]
PO_4	3,990	7.40	3,990	4,330
Si	17.2	0.695	17.2	18.7
SO_4	2,030	287	2,030	2,200
Sr	<2.01	0.00	0.00	0.00
TOC	1,020	5.91	1,020	1,110
U	<100	0.922	0.922	1.00
Zr	<2.01	0.00914	0.00 [4]	0.00 [4]

Table D3-8. Supernatant Non-Radionuclide Inventory Estimate for Tank 241-SY-102. (2 sheets)

Analyte	Supernatant Analytical Value[1]	HDW SMM Value[2]	Best-Basis Value	Inventory Estimate[3]
	μg/mL	μg/mL	μg/mL	kg
Water (wt%)	85.9	94.9	85.9	1.01E+06
SpG	1.08	1.03	1.08	n/a

Notes:

[1]Appendix B, Tables B2-17 through B2-73, sample 2SY-96-2.
[2]Agnew et al. (1997a); SMM concentrations in μg/g times SMM specific gravity of 1.03.
[3]Based on a supernatant volume of 1,080 kL (287 kgal).
[4]Best-basis values set to zero based on engineering judgment; see text for discussion.
[5]Best-basis mercury value set to zero per Simpson (1998).
[6]Total hydroxide value determined from charge balance; see text for discussion.

Table D3-9. Supernatant Radionuclide Inventory Estimate for Tank 241-SY-102: Decay Corrected to January 1, 1994. (3 sheets)

Analyte	Supernatant Analytical Value[1]	HDW SMM Value[2]	Best-Basis Value	Inventory Estimate[3]
	μCi/mL	μCi/mL	μCi/mL	Ci
^{3}H	n/r	6.80E-05	6.80E-05	0.0737
^{14}C	n/r	9.32E-06	9.32E-06	0.0101
^{59}Ni	n/r	5.31E-07	5.31E-07	5.76E-04
^{60}Co	<0.00145	1.19E-05	1.19E-05	0.0130
^{63}Ni	n/r	5.23E-05	5.23E-05	0.0567
^{79}Se	n/r	1.09E-06	1.09E-06	0.00118
^{90}Sr	0.00803	0.0342	0.00803	8.70
^{90}Y	n/r	0.0342	0.00803 [4]	8.70 [4]
^{93}Zr	n/r	5.31E-06	5.31E-06	0.00576
^{93m}Nb	n/r	3.89E-06	3.89E-06	0.00422
^{99}Tc	n/r	7.01E-05	7.01E-05	0.0761
^{106}Ru	n/r	2.95E-09	2.95E-09	3.19E-06
^{113m}Cd	n/r	2.70E-05	2.70E-05	0.0293
^{125}Sb	n/r	6.22E-05	6.22E-05	0.0675
^{126}Sn	n/r	1.67E-06	1.67E-06	0.00181
^{129}I	n/r	1.36E-07	1.36E-07	1.47E-04

Table D3-9. Supernatant Radionuclide Inventory Estimate for Tank 241-SY-102: Decay Corrected to January 1, 1994. (3 sheets)

Analyte	Supernatant Analytical Value[1]	HDW SMM Value[2]	Best-Basis Value	Inventory Estimate[3]
	μCi/mL	μCi/mL	μCi/mL	Ci
^{134}Cs	n/r	8.92E-06	8.92E-06	0.00967
^{137}Cs	39.5	0.0705	39.5	42,800
^{137m}Ba	n/r	0.0666	37.4 [5]	40,500 [5]
^{151}Sm	n/r	0.00387	0.00387	4.20
^{152}Eu	n/r	1.35E-06	1.35E-06	0.00146
^{154}Eu	n/r	1.96E-04	1.96E-04	0.212
^{155}Eu	n/r	8.26E-05	8.26E-05	0.0896
^{226}Ra	n/r	4.69E-11	4.69E-11	5.08E-08
^{227}Ac	n/r	2.87E-10	2.87E-10	3.12E-07
^{228}Ra	n/r	8.98E-08	8.98E-08	9.74E-05
^{229}Th	n/r	2.08E-09	2.08E-09	2.26E-06
^{231}Pa	n/r	1.24E-09	1.24E-09	1.34E-06
^{232}Th	n/r	9.29E-09	9.29E-09	1.01E-05
^{232}U	n/r	2.85E-07	2.85E-07	3.09E-04
^{233}U	n/r	1.09E-06	1.09E-06	0.00118
^{234}U	n/r	3.90E-07	3.90E-07	4.23E-04
^{235}U	n/r	1.51E-08	1.51E-08	1.64E-05
^{236}U	n/r	2.26E-08	2.26E-08	2.45E-05
^{237}Np	n/r	2.48E-07	2.48E-07	2.69E-04
^{238}U	< 3.36E-05[6]	3.08E-07[7]	3.08E-07[7]	3.34E-04
^{238}Pu	n/r	8.83E-07	8.40E-09[8]	9.12E-06[8]
^{239}Pu	1.22E-05[8]	0.00128	1.22E-05[8]	0.0132[8]
^{240}Pu	3.04E-06[8]	3.19E-04	3.04E-06[8]	0.00330[8]
^{241}Pu	n/r	7.56E-05	7.20E-07[8]	7.81E-04[8]
^{241}Am	< 8.26E-06	0.00450	8.26E-06	0.00895
^{242}Pu	n/r	3.41E-10	3.25E-12[8]	3.52E-09[8]
^{242}Cm	n/r	5.01E-08	9.18E-11 [8]	9.96E-08 [8]

Table D3-9. Supernatant Radionuclide Inventory Estimate for Tank 241-SY-102: Decay Corrected to January 1, 1994. (3 sheets)

Analyte	Supernatant Analytical Value[1] μCi/mL	HDW SMM Value[2] μCi/mL	Best-Basis Value μCi/mL	Inventory Estimate[3] Ci
^{243}Am	n/r	1.04E-09	1.91E-12[8]	2.07E-09[8]
^{243}Cm	n/r	4.91E-09	4.91E-09	5.33E-06
^{244}Cm	n/r	5.01E-08	5.01E-08	5.43E-05

Notes:

[1]From Appendix B, Tables B2-50 (uranium by ICP) and B2-65 through B2-69. Decay corrected from January 26, 1997, to January 1, 1994.

[2]Agnew et al. (1997a); SMM concentrations in μCi/g times SMM specific gravity estimate of 1.03.

[3]Based on a supernatant volume of 1,080 kL (287 kgal).

[4]The ^{90}Y activity estimated as one times the ^{90}Sr value.

[5]The ^{137m}Ba activity estimated as 0.946 times the ^{137}Cs value

[6]Estimated from total uranium by ICP/AES and assuming ^{238}U is the major contributor to the total uranium value; converted from value in μg/g to μCi/g using specific activity from Kirkpatrick and Brown (1984).

[7]The SMM ^{238}U activity of 3.08E-07 μCi/mL given here is calculated from a ^{238}U activity of 2.99E-07 μCi/g. This value differs from the incorrect SMM value of 3.83E-07 μCi/g listed in Agnew et al. (1997a). The correct value of 2.99E-07 μCi/g was computed from the Agnew et al. (1997a) value of 0.895 μg/g total uranium minus the mass contributed from ^{235}U.

[8]These activity values were calculated using sample-based $^{239/240}$Pu and ^{241}Am values and isotopic ratios from the SMM; see text for further discussion.

D3.5.2.2 Comparison of Supernatant Composition Estimates. A comparison of the sample-based and the SMM-based concentration values shows a poor match between the two data sets. This observation calls into question the assumption that the SMM estimate of Agnew et al. (1997a) is a reasonable model of the current supernatant composition in tank 241-SY-102. A better model might be a linear combination of HDW supernatant models that more closely matches the likely composition of the salt well-pumped liquid from the single-shell tanks in West Area. Generating such a model is outside the scope of this TCR. However, because sample-based data for the major chemical and radiochemical constituents in the supernatant layer do exist, the effect of using an inadequate HDW model will be mostly relegated to the minor constituents.

D3.5.2.3 Supernatant Inventory Estimates: Mass Balance Check. The assumptions used in generating the supernatant inventory estimates for the nonradioactive components shown in Table D3-8 may be checked by estimating the mass of the supernatant layer in tank 241-SY-102 using two *independent* methods. The mass of the supernatant may be estimated by: 1) multiplying the volume of the static supernatant layer (1,080 kL [287 kgal]) by the supernatant specific gravity (1.08) and 2) summing the masses of the individual best-basis chemical components shown in Table D3-8. The summation performed in method 2 assumes the same chemical speciation as that assumed for the charge balance calculation discussed previously in this section. Note that method 2 indeed generates a mass estimate independent of method 1; the sum of the inventory estimates for the individual best-basis components is *not* constrained by the supernatant volume because the total hydroxide inventory is constrained only by charge balance and not by the supernatant volume.

The mass calculated by both methods is 1,170 metric tons. The agreement between the two methods gives additional confidence that the data, assumptions, and methods used to generate the best-basis values for the supernatant are reasonable, and that no major analytes are missing from the best-basis analysis.

D3.6 COMBINED ESTIMATED COMPONENT INVENTORIES

Sections D3.4 and D3.5 show the derivation of estimated component inventories for the sludge and supernatant volumes in tank 241-SY-102. In this section, the two inventories are combined to generate an overall inventory for the static portion of the tank contents. Tables D3-10 and D3-11 present the combined inventory for the chemical and radionuclide components in the tank waste. No comparison is made with the HDW inventory because the HDW inventory is based on a supernatant with a different volume and composition.

With regard to the radionuclides, the primary observation is that the sludge layer tends to dominate the tank radionuclide inventory. The only exception to this observation is for those few soluble radionuclides, the most notable of which is ^{137}Cs.

Table D3-10. Combined Non-Radionuclide Inventory Estimate for Tank 241-SY-102. (2 sheets)

Analyte	Solids Inventory[1] kg	Supernatant Inventory[2] kg	Combined Inventory kg
Al	13,000	5,540	18,500
Bi	495	0.00	495
Ca	766	21.8	788
Cl	952	1,210	2,170

Table D3-10. Combined Non-Radionuclide Inventory Estimate for Tank 241-SY-102. (2 sheets)

Analyte	Solids Inventory[1] kg	Supernatant Inventory[2] kg	Combined Inventory kg
TIC as CO_3	10,800	8,130	18,900
Cr	4,800	1,020	5,820
F	658	647	1,310
Fe	5,110	0.00	5,110
Hg	0.00	0.00	0.00
K	534	2,280	2,810
La	31.4	0.00	31.4
Mn	1,700	0.00	1,700
Na	30,800	50,900	81,700
Ni	73.5	0.00	73.5
NO_2	12,700	15,700	28,400
NO_3	41,000	52,300	93,300
OH_{Total}	25,600	20,300	45,900
Pb	391	0.00	391
PO_4	11,800	4,330	16,100
Si	480	18.7	499
SO_4	2,180	2,200	4,380
Sr	22.2	0.00	22.2
TOC	2,970	1,110	4,070
U	550	1.00	551
Zr	29.1	0.00	29.1
Water	2.25E+05	1.01E+06	1.23E+06

Notes:

[1]From Table D3-6.
[2]From Table D3-8.

Table D3-11. Combined Radionuclide Inventory Estimate for Tank 241-SY-102 Decay Corrected to January 1, 1994. (2 sheets)

Analyte	Solids Inventory[1]	Supernatant Inventory[2]	Combined Inventory
	Ci	Ci	Ci
^{3}H	0.269	0.0737	0.343
^{14}C	1.22	0.0101	1.23
^{59}Ni	0.128	5.76E-04	0.129
^{60}Co	50.0	0.0130	50.0
^{63}Ni	12.7	0.0567	12.7
^{79}Se	0.476	0.00118	0.477
^{90}Sr	34,700	8.70	34,700
^{90}Y	34,700	8.70	34,700
^{93}Zr	2.34	0.00576	2.35
^{93m}Nb	1.71	0.00422	1.71
^{99}Tc	23.6	0.0761	23.7
^{106}Ru	9.02E-04	3.19E-06	9.05E-04
^{113m}Cd	12.1	0.0293	12.1
^{125}Sb	23.6	0.0675	23.6
^{126}Sn	0.724	0.00181	0.726
^{129}I	0.129	1.47E-04	0.129
^{134}Cs	0.689	0.00967	0.699
^{137}Cs	10,700	42,800	53,600
^{137m}Ba	10,100	40,500	50,700
^{151}Sm	1,680	4.20	1,690
^{152}Eu	0.581	0.00146	0.582
^{154}Eu	536	0.212	536
^{155}Eu	485	0.0896	485
^{226}Ra	2.13E-05	5.08E-08	2.14E-05
^{227}Ac	1.31E-04	3.12E-07	1.32E-04
^{228}Ra	0.0152	9.74E-05	0.0153
^{229}Th	3.68E-04	2.26E-06	3.71E-04
^{231}Pa	5.88E-04	1.34E-06	5.90E-04
^{232}Th	0.0180	1.01E-05	0.0180

Table D3-11. Combined Radionuclide Inventory Estimate for Tank 241-SY-102 Decay Corrected to January 1, 1994. (2 sheets)

Analyte	Solids Inventory[1]	Supernatant Inventory[2]	Combined Inventory
	Ci	Ci	Ci
^{232}U	0.0899	3.09E-04	0.0902
^{233}U	3.22	0.00118	3.22
^{234}U	0.193	4.23E-04	0.194
^{235}U	0.0100	1.64E-05	0.0100
^{236}U	0.0112	2.45E-05	0.0112
^{237}Np	0.420	2.69E-04	0.420
^{238}U	0.183	3.34E-04	0.184
^{238}Pu	303	9.12E-06	303
^{239}Pu	2,340	0.0132	2,340
^{240}Pu	894	0.00330	894
^{241}Pu	8.98	7.81E-04	8.98
^{241}Am	11,600	0.00895	11,600
^{242}Pu	0.268	3.52E-09	0.268
^{242}Cm	2.55E-04	9.96E-08	2.55E-04
^{243}Am	0.00279	2.07E-09	0.00279
^{243}Cm	0.960	5.33E-06	0.960
^{244}Cm	22.1	5.43E-05	22.1

Notes:

[1]From Table D3-7.
[2]From Table D3-9.

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-SY-102 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task. The following information was used in the evaluation.

- Sludge-weight measurements, core sample recoveries, and grab-sample sludge recoveries to estimate the volume of the sludge layer
- Analytical results from February/March 1990 and July/August 1997 push mode core samples
- Analytical results from a January 14, 1997, grab sample
- Waste component concentration estimates generated by the HDW model for tank 241-SY-102 (Agnew et al. 1997a).

Based on this evaluation, a best-basis inventory was developed for tank 241-SY-102. The sampling-based inventory was chosen as the best basis for those analytes for which analytical values were available. The HDW model results were used if no sample-based information was available. The inventory was calculated based on a sludge volume of 270 kL (71 kgal) and a static supernatant volume of 1,080 kL (287 kgal) for a total static waste volume of 1,350 kL (358 kgal). Because tank 241-SY-102 routinely receives wastes from the 200 West Area operations and serves as the staging tank for cross-site transfers to the 200 East Area double-shell tank farms, the liquid volume in this tank frequently changes. Therefore, the supernatant volume of 1,080 kL was adopted to represent the static supernatant layer below the current administrative minimum of 330 cm (130 in.) for the tank waste (LMHC 1998b). (In contrast to the 1,080 kL supernatant volume used in the best-basis analysis, the total volume of tank supernatant was approximately 2,520 kL [666 kgal] as of March 31, 1998.) To calculate the solids contribution to the best-basis inventory, a solids density of 1.44 g/mL was used; this is the mean value for the July/August 1997 push mode core samples (see Appendix B, Table B2-120).

Best-basis tank inventory values were determined for 25 key chemical species. The best-basis values for mercury were set to zero as specified in Simpson (1998). Once the best-basis inventories were determined for 24 of the species, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997a).

Best-basis tank inventory values were also derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decay corrected to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}Pu$, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, and so forth, have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1, and in Watrous and Wootan 1997.) Model-generated values for radionuclides in any of the 177 Hanford Site tanks are reported in the HDW Rev. 4 model results (Agnew et al. 1997a). The best-basis value for any one analyte may be either a model result or a sample- or engineering assessment-based result, if available.

The best-basis inventory estimate for tank 241-SY-102 is presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database for the most current inventory values.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-SY-102 (Effective March 31, 1998). (2 sheets)

Analyte	Static Waste Inventory[1] (kg)	Basis (S, M, E, or C)	Comment[2]
Al	18,500	S	
Bi	495	S/E	Supernatant inventory estimated to be zero
Ca	788	S/E	Supernatant inventory bounded by method detection limit
Cl	2,170	S	
TIC as CO_3	18,900	S/E	Based on 1990 core sample results
Cr	5,820	S	
F	1,310	S	
Fe	5,110	S/E	Supernatant inventory estimated to be zero
Hg	0.00	E	Per Simpson (1998)
K	2,810	S	
La	31.4	S/E	Supernatant inventory estimated to be zero
Mn	1,700	S/E	Supernatant inventory estimated to be zero
Na	81,700	S	
Ni	73.5	S/E	Supernatant inventory estimated to be zero

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-SY-102 (Effective March 31, 1998). (2 sheets)

Analyte	Static Waste Inventory[1] (kg)	Basis (S, M, E, or C)	Comment[2]
NO_2	28,400	S	
NO_3	93,300	S	
OH_{Total}	45,900	C	
Pb	391	S/E	Supernatant inventory estimated to be zero
PO_4	16,100	S	
Si	499	S	
SO_4	4,380	S	
Sr	22.2	S/E/M	
TOC	4,070	S/E	Solids TOC estimated from 1997 core sample oxalate results
U_{Total}	551	S/E/M	Solids uranium content based on 1997 core sample ICP/MS data
Zr	29.1	S/E	Supernatant inventory estimated to be zero

Notes:

S = Sample-based (see Appendix B), M = HDW model-based, Agnew et al. (1997a), E = Engineering assessment-based, C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

[1]Based on a sludge volume of 270 kL (71 kgal) and a static supernatant volume of 1,080 kL (287 kgal).

[2]Sample-based values are from January 1997 grab sample 2SY-96-2 and the July/August 1997 core samples, unless otherwise noted.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-SY-102 Decay Corrected to January 1, 1994 (Effective March 31, 1998). (3 sheets)

Analyte	Static Waste Inventory[1] (Ci)	Basis (S, M, or E)	Comment[2]
^{3}H	0.343	S/E/M	Based on 1990 core sample results
^{14}C	1.23	S/E/M	Based on 1990 core sample results
^{59}Ni	0.129	M/E	
^{60}Co	50.0	S/E/M	Based on 1990 core sample results
^{63}Ni	12.7	M/E	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-SY-102 Decay Corrected to January 1, 1994 (Effective March 31, 1998). (3 sheets)

Analyte	Static Waste Inventory[1] (Ci)	Basis (S, M, or E)	Comment[2]
^{79}Se	0.477	M/E	
^{90}Sr	34,700	S/E	Based on 1990 core sample results
^{90}Y	34,700	S/E	^{90}Y assumed equal to ^{90}Sr
^{93}Zr	2.35	M/E	
^{93m}Nb	1.71	M/E	
^{99}Tc	23.7	S/E/M	Based on 1990 core sample results
^{106}Ru	9.05E-04	M/E	
^{113m}Cd	12.1	M/E	
^{125}Sb	23.6	M/E	
^{126}Sn	0.726	M/E	
^{129}I	0.129	M/E	
^{134}Cs	0.699	M/E	
^{137}Cs	53,600	S/E	Based on 1990 core sample results
^{137m}Ba	50,700	S/E	Based on 0.946 of ^{137}Cs activity
^{151}Sm	1,690	M/E	
^{152}Eu	0.582	M/E	
^{154}Eu	536	S/E/M	Based on 1990 core sample results
^{155}Eu	485	S/E/M	Based on 1990 core sample results
^{226}Ra	2.14E-05	M/E	
^{227}Ac	1.32E-04	M/E	
^{228}Ra	0.0153	M/E	
^{229}Th	3.71E-04	M/E	
^{231}Pa	5.90E-04	M/E	
^{232}Th	0.0180	S/E/M	Solids value base on ICP-MS data
^{232}U	0.0902	S/E/M	Based on uranium sample result ratioed to HDW estimates for U isotopes
^{233}U	3.22	S/E/M	Solids value based on ICP/MS data
^{234}U	0.194	S/E/M	Based on uranium sample result ratioed to HDW estimates for U isotopes
^{235}U	0.0100	S/E/M	Solids value based on ICP/MS data

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-SY-102 Decay Corrected to January 1, 1994 (Effective March 31, 1998). (3 sheets)

Analyte	Static Waste Inventory[1] (Ci)	Basis (S, M, or E)	Comment[2]
^{236}U	0.0112	S/E/M	Solids value based on ICP/MS data
^{237}Np	0.420	S/E/M	Solids value based on ICP/MS data
^{238}U	0.184	S/E/M	Solids value based on ICP/MS data
^{238}Pu	303	S/E/M	Based on 1990 core sample results
^{239}Pu	2,340	S/E/M	Solids value based on alpha & ICP/MS data; supernatant value based on $^{239/240}Pu$ value and HDW estimates for Pu isotopes
^{240}Pu	894	S/E/M	Solids value based on alpha & ICP/MS data; supernatant value based on $^{239/240}Pu$ value and HDW estimates for Pu isotopes
^{241}Pu	8.98	S/E/M	Based on $^{239/240}Pu$ value and HDW estimates for Pu isotopes
^{241}Am	11,600	S/E	Sample-based ^{241}Am determinations
^{242}Pu	0.268	S/E/M	Solids value based on ICP/MS data; supernatant value based on $^{239/240}Pu$ value and HDW estimates for Pu isotopes
^{242}Cm	2.55E-04	S/E/M	^{214}Am results times HDW estimate of $^{242}Cm/^{241}Am$
^{243}Am	0.00279	S/E/M	Based on ^{241}Am values ratioed to HDW estimates for Am isotopes
^{243}Cm	0.960	S/E/M	Based on 1990 core sample results; ^{243}Cm inventory equals 0.04 times $^{243/244}Cm$ inventory
^{244}Cm	22.1	S/E/M	Based on 1990 core sample results; ^{244}Cm inventory equals 0.96 times $^{243/244}Cm$ inventory

Notes:

S = Sample-based (see Appendix B), M = HDW model-based, Agnew et al. (1997a), E = Engineering assessment-based

[1]Based on a sludge volume of 270 kL (71 kgal) and a static supernatant volume of 1,080 kL (287 kgal).

[2]Sample-based values are from January 1997 grab sample 2SY-96-2 and the July/August 1998 core samples, unless otherwise noted.

D5.0 APPENDIX D REFERENCES

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. FitzPatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997a, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-SY-102

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-SY-102

Appendix E is a bibliography that supports the characterization of tank 241-SY-102. This bibliography represents an in-depth literature search of all known information sources that provide sampling, analysis, surveillance, modeling information, and processing occurrences associated with tank 241-SY-102 and its respective waste types.

The references in this bibliography are separated into three broad categories containing references broken down into subgroups. These categories and their subgroups are listed below.

I. NON-ANALYTICAL DATA

- Ia. Models/Waste Type Inventories/Campaign Information
- Ib. Fill History/Waste Transfer Records
- Ic. Surveillance/Tank Configuration
- Id. Sample Planning/Tank Prioritization
- Ie. Data Quality Objectives/Customers of Characterization Data

II. ANALYTICAL DATA -- SAMPLING OF TANK WASTE AND WASTE TYPES

- IIa. Sampling of Tank 241-SY-102
- IIb. Sampling of Evaporator Saltcake and Z Plant Waste Type

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

- IIIa. Inventories using both Campaign and Analytical Information
- IIIb. Compendium of Existing Physical and Chemical Documented Data Sources

The bibliography is broken down into the appropriate sections of material with an annotation at the end of each reference describing the information source. Most information listed below is available in the Lockheed Martin Hanford Corporation Tank Characterization and Safety Resource Center.

I. NON-ANALYTICAL DATA

Ia. Models/Waste Type Inventories/Campaign Information

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains waste type summaries, primary chemical compound/analyte and radionuclide estimates for sludge, supernatant, and solids, as well as SMM, TLM, and individual tank inventory estimates.

Jungfleisch, F. M., and B. C. Simpson, 1993, *Preliminary Estimation of the Waste Inventories in Hanford Tanks Through 1980*, WHC-SD-WM-TI-057, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- A model based on process knowledge and radioactive decay estimations using ORIGEN for different compositions of process waste streams assembled for total, solution, and solids compositions per tank. Assumptions about waste/waste types and solubility parameters and constraints are also given.

Ib. Fill History/Waste Transfer Records

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Waste Status and Transaction Record Summary, WSTRS Rev. 4*, LA-UR-97-311, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains spreadsheets showing all known tank additions/transfers.

Koreski, G. M., 1998, *Double-Shell Tanks Inventory and Material Balance for May 1998*, (internal memorandum 7A140-98-027 to Distribution, June 15), Lockheed Martin Hanford Corp. for Flour Daniel Hanford, Inc., Richland, Washington.

- Contains tank transfer data and tank inventory information for all double-shell tanks.

Ic. Surveillance/Tank Configuration

Lipnicki, J., 1997, *Waste Tank Risers Available for Sampling*, WHC-SD-WM-TI-710, Rev. 4, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Assesses riser locations for each tank; however, not all tanks are included/completed. Also includes an estimate of the risers available for sampling.

Tardiff, G. R., 1998, *Double-Shell Underground Waste Storage Tanks Riser Survey*, WHC-SD-RE-TI-093, Rev. 4D, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Shows tank riser locations in relation to tank aerial view as well as a description of riser and its contents.

Tran, T. T., 1993, *Thermocouple Status Single-Shell & Double-Shell Waste Tanks*, WHC-SD-WM-TI-553, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Provides thermocouple location and status information for double- and single-shell tanks.

Welty, R. K., 1988, *Waste Storage Tank Status and Leak Detection Criteria*, WHC-SD-WM-TI-356, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Provides leak detection information for all single- and double-shell tanks. Liquid level, liquid observation well, and dry well readings are included.

Id. Sample Planning/Tank Prioritization

Brown, T. M., J. W. Hunt, and L. J. Fergestrom, 1997, *Tank Waste Characterization Basis*, WHC-SD-WM-TA-164, Rev. 3, Westinghouse Hanford Company, Richland, Washington.

- Establishes an approach to determine the priority for tank sampling and characterization and identifies high-priority tanks for sampling.

Estey, S. D., and M. A. Beck, 1995, *Test Plan, TRU Solubility Mixing and Boildown Studies For U Tank Farm Stabilization Activities*, (internal letter 74A10-95-069 to J. R. Jewett, October 2), Westinghouse Hanford Company, Richland, Washington.

- Requests specific compositing, physical and chemical analyses.

Hall, B. W., 1990, *Tank 102-SY Core Sample*, (internal letter 13316-90-009 to R. L. Weiss, February 7), Westinghouse Hanford Company, Richland, Washington.

- Requests specific physical and chemical analyses for core sample.

Sasaki, L. M., 1988, *Tank 102-SY Core Sample*, (internal letter 13316-88-098 to R. L. Weiss, November 18), Westinghouse Hanford Company, Richland, Washington.

- Requests specific extrusion handling and physical and chemical analyses for core sample.

Sasaki, L. M., 1996, *Compatibility Grab Sampling and Analysis Plan For FY 1997*, WHC-SD-WM-TSAP-115, Rev. 0C, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains detailed sampling and analysis (including solids) scheme for grab samples to be taken from various tanks including tank 241-SY-102 to address applicable DQOs.

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Sasaki, L. M., 1998, *Compatibility Grab Sampling and Analysis Plan For FY 1998*, HNF-SD-WM-TSAP-150, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains detailed sampling and analysis scheme for grab samples to be taken from various tanks, including tank 241-SY-102, to address applicable DQOs.

Schreiber, R. D., 1995, *Compatibility Grab Sampling and Analysis Plan*, WHC-SD-WM-TSAP-037, Rev. 1B, Westinghouse Hanford Company, Richland, Washington.

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Stanton, G. A., 1997, *Baseline Sampling Schedule, Change 98-01*, (internal letter 79520-98-001 to Distribution, February 5), Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Provides a tank waste sampling schedule through fiscal year 2002 and lists samples taken since 1994.

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- Contains requirements from the *Hanford Federal Facility Agreement and Consent Order*, *Recommendation 93-5 Implementation Plan*, and other requirement sources. These, along with managerial and operational constraints, are combined to summarize the TWRS characterization program deliverables for fiscal years 1997 and 1998.

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- Uses chemical analysis data for compatibility assessment.

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- Uses chemical analysis data for compatibility assessment.

Gray, R., 1991, *Retrieval and Dissolution of TK 241-SY-102 Waste*, (internal letter 28110-PCL91-004 to S. S. Lowe, February 22), Westinghouse Hanford Company, Richland, Washington.

- Documents pretreatment testing results.

Herting, D. L., 1994, *TRU Solubility Mixing Study For Tanks T-111 and 102-SY*, (internal letter 12110-PCL94-030 to M. J. Sutey, April 4), Westinghouse Hanford Company, Richland, Washington.

- Documents compatibility mixing study results.

Jones, T. E., and K. D. Wiemers, 1996, *Data Requirements for TWRS Privatization Characterization of Potential Low Activity Waste Feed*, WHC-SD-WM-DQO-023, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Used to attain characteristic data for process development, conceptual design, feed staging, and to meet Envelope A, B, and C specifications.

Kupfer, M. J., 1995, *Strategy for Sampling Hanford Site Tank Wastes for Development of Disposal Technology*, WHC-SD-WM-TA-154, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Contains sample strategy to meet pretreatment and disposal data needs and list of tanks to be evaluated.

Meacham, J. E., D. L. Banning, M. R. Allen, and L. D. Muhlestein, 1997, *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue*, HNF-SD-WM-DQO-026, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Defines sample and data requirements to assess organic solvent pool issues in tank waste.

Mulkey, C. H., and K. D. Markillie, 1995, *Data Quality Objective for Regulatory Requirements for Hazardous and Radioactive Air Emissions Sampling and Analysis*, WHC-SD-WM-DQO-021, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Defines sample and data requirements to assess tank waste compliance with air emissions regulations.

Mulkey, C. H., and M. S. Miller, 1997, *Data Quality Objectives for Tank Farms Waste Compatibility Program*, HNF-SD-WM-DQO-001, Rev. 2, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Defines sample and data requirements to assess compatibility of tank wastes prior to tank waste transfers.

Slankas, T. J., M. J. Kupfer, and W. W. Schultz, 1995, *Data Needs and Attendant Data Quality Objectives for Tank Waste Pretreatment and Disposal*, WHC-SD-WM-DQO-022, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains data needs for pretreatment and disposal, including information on sludge washing, solid/liquid separation, and Cs, Sr, and TRU removal.

Sutey, M. J., 1994, *Waste Compatibility Assessment of Tank 241-SY-102 with Tank 241-T-111 Via 244-TX DCRT*, (internal letter 7CF30-94-011 to J. H. Wicks, April 8), Westinghouse Hanford Company, Richland, Washington.

- Uses grab sample analysis results for compatibility assessment.

Sutey, M. J., 1994, *Waste Compatibility Assessment of Tank 241-SY-102 with Tank 241-U-111 via 244-U DCRT*, (internal letter 71720-94-039 to D. P. Reber, November 30), Westinghouse Hanford Company, Richland, Washington.

- Uses grab sample analysis results for compatibility assessment.

Sutey, M. J., 1995, *Waste Compatibility Assessment of Tank 241-AP-104 with Tank 241-SY-102*, (internal letter 71720-95-008 to J. H. Wicks, March 24), Westinghouse Hanford Company, Richland, Washington.

- Uses grab sample analysis results for compatibility assessment.

Sutey, M. J., 1995, *Waste Compatibility Review of Cross-Site Pressure Test Water*, (internal letter 77240-95-018 to D. P. Reber, May 27), Westinghouse Hanford Company, Richland, Washington.

- Uses compatibility chemical analysis (sample T560) data for safe mixing.

Sutey, M. J., 1995, *Waste Compatibility Assessment of Tank 241-S-101, Tank 241-S-103, Tank 241-S-106, Tank 241-S-107, Tank 241-S-108, Tank 241-S-109, Tank 241-S-110 Waste with Tank 241-SY-102 via DCRT 244-S*, (internal letter 77240-95-030 to S. H. Rafaey, December 4), Westinghouse Hanford Company, Richland, Washington.

- Uses grab sample analysis results for compatibility assessment.

Turner, D. A., H. Babad, L. L. Buckley, and J. E. Meacham, 1995, *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue*, WHC-SD-WM-DQO-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

- Used to categorize organic tanks as "safe," "conditionally safe," or "unsafe" based on fuel and moisture concentrations, and to support resolution of the safety issue.

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

IIa. Sampling of Tank 241-SY-102

Anderson, S. I., 1989, *Site Characterization Requirements For Tank 241-SY-102 Waste Solution Prior To Cross-Site Transfer To Tank 241-AY-101*, (internal letter 89-246-SIA to A. R. Shade, August 22), Westinghouse Hanford Company, Richland, Washington.

- Contains October 1988, March and June 1989 sample analysis results.

Beck, M. A., 1997, *Results, TRU Solubility Mixing and Boildown Studies for U Tank Farm Stabilization Activities*, (internal letter 8C510-PCS96-099 to D. J. Saueressig, January 22), Numatec Hanford Company for Fluor Daniel Hanford, Inc., Richland, Washington.

- Reports results of TRU solubility mixing and boildown studies.

Bratzel, D. R., 1984, *Characterization of Supernatant from Tank 102-SY*, (internal letter 65453-84-320 to D. M. Tulberg, October 5), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Bratzel, D. R., 1984, *DSI*, (DSI to D. M. Tulberg, October 11), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Bratzel, D. R., 1984, *Characterization of Supernatant from Tank 102-SY*, R-3326, (internal letter 65453-84-325 to D. M. Tulberg, October 16), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Bratzel, D. R., 1984, *Characterization of 102-SY Supernatant*, (internal letter 65453-84-143 to D. M. Tulberg, November 7), Rockwell Hanford Operations, Richland, Washington.

- Contains historical supernatant sample analysis results.

Bratzel, D. R., 1984, *Characterization of Tk 102-SY Supernatant*, R-3326, (internal letter 65453-84-374 to D. M. Tulberg, December 31), Rockwell Hanford Operations, Richland, Washington.

- Contains historical supernatant sample analysis results.

Bratzel, D. R., 1985, *Tank 102-SY Plutonium Settling Study*, (internal letter 65453-85-006 to L. A. Gale, January 10), Rockwell Hanford Operations, Richland, Washington.

- Contains historical settled solid sample analysis results.

Bratzel, D. R., 1985, *Characterization of Tank 102-SY Waste*, (internal letter 65453-85-064 to L. A. Gale, March 29), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Bratzel, D. R., 1984, *Plutonium Finishing Plant Laboratory Study*, (internal letter to D. M. Tulberg, May 11), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Buckingham, J. S., 1977, *Double Shell Slurry Test*, (internal letter to R. E. Van der Cook, May 17), Atlantic Richfield Hanford Company, Richland, Washington.

- Contains historical sample analysis results.

Delegard, C. H., 1979, *Activity Reduction, Suspended Solids identification, and Hot Boildown of Tank 102-SY Waste Liquor*, (internal letter 65124-79-052 to H. J. Eding, December 27), Rockwell Hanford Operations, Richland, Washington.

- Contains historical suspended solids sample analysis results.

Esch, R. A., 1995, *60-Day Waste Compatibility Safety Issue and Final Results for Tank 241-SY-102, Grab Samples 2SY-95-1 and 2SY-95-2*, WHC-SD-WM-DP-159, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains October 1995 grab sample analysis results.

Herting, D. L., 1990, *Characterization of Solids From Tank 241-SY-102*, (internal letter 16220-PCL90-082 to L. M. Sasaki, July 6), Westinghouse Hanford Company, Richland, Washington.

- Contains archive 1988 core sample analysis results.

Hill, J. G., 1991, *Worst Case Radionuclide Concentrations For SY Tank Farm*, (internal letter 86431-91-008 to J. M. Light, January 21), Westinghouse Hanford Company, Richland, Washington.

- Contains October 1988 core sample analysis results.

Jansky, M. T., 1980, *Composition of Tank 102SY Waste*, (internal letter 65453-80-292 to D. E. Bowers, October 6), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Jansky, M. T., 1980, *Actual Double Shell Slurry Feed*, (internal letter 65453-80-347 to D. E. Bowers, November 20), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Jansky, M. T., 1982, *Tank 102SY Sample; Cross-site Transfer Assessment*, (internal letter 65453-82-438 to P. J. Certa, December 7), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Jones, B. L., 1988, *Future Use of SY Tank Farm and Predicted Vapor Characteristics*, (internal letter to N. R. Kerr, December 6), Westinghouse Hanford Company, Richland, Washington.

- Contains estimated vapor sample analysis results.

Kruszka, J. T., 1986, *Cross-site Transfer Sample Results*, (DSI to K. G. Carothers, March 6), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Lane, T. A., 1979, *Partial Neutralization Run: 102-SY Material*, (internal letter 65120-79-116 to K. G. Carothers, July 25), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Manager, Special Analysis, 1977, *Analyses of Tank Farm Samples, Serial No. 3258, Tank 102-SY (242-S FD), Received 12/5/77*, (internal letter to B. Christensen, December 20), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1977, *Analyses of Tank Farm Samples, Serial No. 3476, Tank 102-SY (242-S FDA), Received 12/11/77*, (internal letter to B. Christensen, December 20), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1977, *Analyses of Tank Farm Samples, Serial No. 3376, Tank 102-SY (242-S FDA), Received 12/8/77*, (internal letter to B. Christensen, December 20), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 2416, Tank 102-SY 242-S FDN, Received 11/16/77*, (internal letter to B. Christensen, January 3), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 2871, Tank 102-SY (242-S FDN), Received 11/26/77*, (internal letter to B. Christensen, January 3), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 4780, Tank 102-SY, Received 1/18/78*, (internal letter to B. Christensen, January 31), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 5203, Tank 102-SY, Received 1/29/78*, (internal letter to B. Christensen, February 7), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 5383, Tank 102-SY, Received 2/2/78*, (internal letter to B. Christensen, February 7), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 7516, Tank 102-SY, Received 3/28/78*, (internal letter to D. R. Autrey, May 24), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 7943, Tank 102-SY, Received 4/9/78*, (internal letter to D. R. Autrey, May 24), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 8067, Tank 102-SY, Received 4/12/78*, (internal letter to D. R. Autrey, May 24), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 8265, Tank 102-SY, Received 4/17/78*, (internal letter to D. R. Autrey, June 29), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 2118, Tank 102-SY, Received 7/30/78*, (internal letter, addressee unknown, September 1), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 2954, Tank 102-SY, Received 8/18/78*, (internal letter, addressee unknown, September 1), Rockwell Hanford Operations, Richland, Washington.

- Contains historical grab sample analysis results.

Manager, Special Analysis, 1979, *Analyses of Tank Farm Samples, Serial No. 9672, Tank 102 SY, Received 5/8/79*, (internal letter, addressee and date unknown), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Nuzum, J. L., 1997, *Waste Compatibility Safety Issues and Final Results for Tank 241-SY-102 Grab Samples*, HNF-SD-WM-DP-227, Rev. 0, Waste Management of Hanford, Inc., Richland, Washington.

- Contains January 1997 grab sample analysis results.

Peterson, M. E., 1990, *Letter Report - Results of the Characterization of Samples of Waste From Double-Shell Tank 102-SY - January 1990*, (external letter 9000455 to A. J. Diliberto, Westinghouse Hanford Company, January 19), Pacific Northwest Laboratories, Richland, Washington.

- Contains October 1988 core sample analysis results.

Peterson, M. E., 1989, *Letter Report - Results of the Characterization of Samples of Waste From Double-Shell Tank 102-SY*, (external letter 8902770 to A. J. Diliberto, Westinghouse Hanford Company, June 30), Pacific Northwest Laboratories, Richland, Washington.

- Contains October 1988 core sample analysis results; the Peterson (1990) letter superseded this letter.

Saueressig, D. J., 1989, *Cross-Site Transfer Sample Analysis*, (internal letter 13331-89-326 to D. G. Baide, August 28), Westinghouse Hanford Company, Richland, Washington.

- Contains August 1989 supernatant sample analysis results.

Steen, F. H., 1998, *Tank 241-SY-102 Cores 211 and 213 Analytical Results For the Final Report*, HNF-SD-WM-DP-267, Rev. 0, Waste Management Federal Services of Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains July/August 1997 core sample analysis results.

Tingey, J. M. and L. M. Sasaki, 1995, *Analysis of FY 1990 Core Samples from Tank 241-SY-102*, WHC-SD-WM-TI-683, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains February/March 1990 core sample analysis results.

Weiss, R. L., 1989, *Mixing Study: 241-SX-104 Supernatant/241-SY-102 Solids*, (internal letter 12712-PCL89-060 to K. G. Carothers, March 23), Westinghouse Hanford Company, Richland, Washington.

- Contains June and July 1988 supernatant and settled solids sample analysis results.

Weiss, R. L., 1989, *Analysis of Liquid Sample From Tank 241-SY-102*, (internal letter 12712-PCL89-112 to V. C. Boyles, May 2), Westinghouse Hanford Company, Richland, Washington.

- Contains March 1989 supernatant sample analysis results.

Weiss, R. L., 1989, *Analysis of Liquid Sample From Tank 241-SY-102 Taken June 2, 1989*, (internal letter 12712-PCL89-149 Rev. 1 to D. J. Saueressig, August 29), Westinghouse Hanford Company, Richland, Washington.

- Contains June 1989 sample analysis results.

Weiss, R. L., 1989, *Analysis of Liquid Sample From Tank 241-SY-102*, (internal letter 12712-PCL89-109 to B. E. Campbell, April 27), Westinghouse Hanford Company, Richland, Washington.

- Contains March 1989 supernatant sample analysis results.

Weiss, R. L., 1990, *November 1988 Core Sample From Tank 241-SY-102, Process Chemistry Laboratory Efforts*, (internal letter 16500-90-085 to N. W. Kirch, November 19), Westinghouse Hanford Company, Richland, Washington.

- Contains November 1988 core sample analysis results.

Weiss, R. L., 1990, *Additional Information on 102-SY Core Sample*, (DSI to L. A. Bray, January 8), Westinghouse Hanford Company, Richland, Washington.

- Contains October 1988 core sample analysis results.

WHC, 1993, *Sample Status Report For R 3355, 102-SY*, (data sheet, printed 3/12), Westinghouse Hanford Company, Richland, Washington.

- Contains March 1993 supernatant sample analysis results.

WHC, 1993, *Sample Status Report For R 3354, 102-SY*, (data sheet, printed 3/12), Westinghouse Hanford Company, Richland, Washington.

- Contains March 1993 supernatant sample analysis results.

WHC, 1993, *Sample Status Report For R 3353, 102-SY*, (data sheet, printed 3/12), Westinghouse Hanford Company, Richland, Washington.

- Contains March 1993 sample analysis results.

WHC, 1992, *Data Sheet for Tank 102 SY*, Date of Analysis: 3/6/84, Sample Number: T1183, Westinghouse Hanford Company, Richland, Washington.

- Contains March 1984 sample analysis results.

WHC, 1992, *Data Sheet for Tank 102 SY*, Date of Analysis: 1/19/86, Sample Number: R7878, Westinghouse Hanford Company, Richland, Washington.

- Contains January 1986 supernatant sample analysis results.

WHC, 1992, *Data Sheet for Tank 102 SY*, Date of Analysis: 3/27/84, Sample Number: T1946, Westinghouse Hanford Company, Richland, Washington.

- Contains March 1984 sample analysis results.

WHC, 1990, *Data Sheet for Tank 102 SY*, Date of Analysis: 10/5/84, Sample Number R-3036, Westinghouse Hanford Company, Richland, Washington.

- Contains October 1984 supernatant sample analysis results.

WHC, 1990, *Data Sheet for Tank 102 SY*, Date of Analysis: 10/5/84, Sample Number: R-3038, Westinghouse Hanford Company, Richland, Washington.

- Contains October 1984 supernatant sample analysis results.

WHC, 1984, *Sample Status Report For R3144*, (data sheet, printed 9/14), Westinghouse Hanford Company, Richland, Washington.

- Contains September 1984 supernatant sample analysis results.

WHC, 1984, *Sample Status Report For R3145*, (data sheet, printed 9/14), Westinghouse Hanford Company, Richland, Washington.

- Contains September 1984 supernatant sample analysis results.

WHC, 1984, *Sample Status Report For R3146*, (data sheet, printed 9/14), Westinghouse Hanford Company, Richland, Washington.

- Contains September 1984 supernatant sample analysis results.

WHC, 1984, *Sample Status Report For R3147*, (data sheet, printed 9/14), Westinghouse Hanford Company, Richland, Washington.

- Contains September 1984 supernatant sample analysis results.

WHC, 1984, *Sample Status Report For R3149*, (data sheet, printed 9/14), Westinghouse Hanford Company, Richland, Washington.

- Contains September 1984 supernatant sample analysis results.

WHC, 1984, *Sample Status Report For R3150*, (data sheet, printed 9/14), Westinghouse Hanford Company, Richland, Washington.

- Contains September 1984 supernatant sample analysis results.

WHC, 1984, *Sample Status Report For R3154*, (data sheet, printed 9/14), Westinghouse Hanford Company, Richland, Washington.

- Contains September 1984 supernatant sample analysis results.

WHC, 1989, *Sample Status Report For R 4770*, (data sheet, printed 5/22), Westinghouse Hanford Company, Richland, Washington.

- Contains March 1989 supernatant sample analysis results.

WHC, 1989, *Sample Status Report For R 4769*, (data sheet, printed 5/22), Westinghouse Hanford Company, Richland, Washington.

- Contains March 1989 supernatant sample analysis results.

WHC, 1989, *Sample Status Report For R 4330*, (data sheet, printed 1/4), Westinghouse Hanford Company, Richland, Washington.

- Contains November 1988 supernatant sample analysis results.

WHC, 1989, *Sample Status Report For R 4331*, (data sheet, printed 1/4), Westinghouse Hanford Company, Richland, Washington.

- Contains November 1988 supernatant sample analysis results.

WHC, 1989, *Sample Status Report For R 4332*, (data sheet, printed 1/4), Westinghouse Hanford Company, Richland, Washington.

- Contains November 1988 supernatant sample analysis results.

WHC, 1990, *Data Sheet for Tank 102 SY*, Date of Analysis: 10/5/84, Sample Number: R-3037, Westinghouse Hanford Company, Richland, Washington.

- Contains October 1984 supernatant sample analysis results.

WHC, 1992, *Report Analysis, Date of Analysis = 3/06/84, Sample Number = T1183*, (data sheet printed March 5), Westinghouse Hanford Company, Richland, Washington.

- Contains historical sample analysis results.

WHC, 1992, *Report Analysis, Date of Analysis = 3/27/84, Sample Number = T1946*, (data sheet printed March 5), Westinghouse Hanford Company, Richland, Washington.

- Contains historical sample analysis results.

WHC, 1992, *Report Analysis, Date of Analysis = 1/19/86, Sample Number = R-7878*, (data sheet printed March 5), Westinghouse Hanford Company, Richland, Washington.

- Contains historical sample analysis results.

Wilson-Wright, S. B., 1981, *Analysis and Viscosity of Tank 102-SY Waste*, (internal letter 65453-81-261 to M. C. Teats, August 4), Rockwell Hanford Operations, Richland, Washington.

- Contains historical sample analysis results.

Winters, W. I., 1995, *Tank Characterization Report for Double-Shell Tank 241-SY-102*, WHC-SD-WM-ER-366, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains 1988 and 1990 core sample and March 1994 analysis results.

IIb. Sampling of Evaporator Saltcake and Z Plant Waste Type

Bratzel, D. R., and R. M. Cleavenger, 1984, *Tank 102-SY Plutonium Solubility Study*, (internal letter 65453-84-352 to D. M. Tulberg, November 15), Rockwell Hanford Operations, Richland, Washington.

- Contains characteristic salt well liquor and Z Plant waste compositions and concentrations.

Bratzel, D. R., 1984, *Solids Characterization of Synthetic PFP-Z Solids*, (internal letter 65453-84-326 to D. M. Tulberg, October 18), Rockwell Hanford Operations, Richland, Washington.

- Contains synthetic Z Plant sample compositions and concentrations.

Bratzel, D. R., 1984, *Characterization of PRF Sump Sample*, (internal letter 65453-84-342 to D. M. Tulberg, November 8), Rockwell Hanford Operations, Richland, Washington.

- Contains Z Plant sample compositions and concentrations.

Campbell, G. D., 1975, *242-S Evaporator-Crystallizer Material Balance*, (internal letter to R. L. Walser, August 5), Atlantic Richfield Hanford Company, Richland, Washington.

- Contains 242-S Evaporator feed and product compositions.

Certa, P. J., 1985, *242-A Evaporator/Crystallizer FY 84 Campaign Run 84-3 Post Run Document*, RHO-SD-WM-PE-018, Rev. 0, Rockwell Hanford Operations, Richland, Washington.

- Contains information on waste from SY-102 fed through the evaporator.

Gale, L. A., and R. C. Brown, 1984, *Potential Hanford Waste Vitrification Plant Impacts From Chemical Neutron Poisons Addition Alternatives To Plutonium Reclamation Facility Wastes in Tank 102-SY*, (internal letter 65612-84-063 to D. M. Tulberg, April 24), Rockwell Hanford Operations, Richland, Washington.

- Contains PFP flowsheet waste compositions.

Landeene, B. C., 1993, *Draft Preliminary Conceptual Flowsheet for Plutonium Finishing Plant Chromium Leaching (Sludge Waste Pretreatment)*, WHC-SD-WM-TI-539, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Gives nominal composition of PFP waste.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 1986, Tank 242-A FD, Received 7/27/78*, (internal letter, August 10), Rockwell Hanford Operations, Richland, Washington.

- Contains 242-A Evaporator Feed historical grab sample analysis results.

Manager, Special Analysis, 1978, *Analyses of Tank Farm Samples, Serial No. 2157, Tank 001 CR 242-A FD, Received 7/31/78*, (internal letter, addressee unknown, September 1), Rockwell Hanford Operations, Richland, Washington.

- Contains 242-A Evaporator Feed historical grab sample analysis results.

Pejunen, A. L., and R. A. Watrous, 1994, *Plutonium and Americium Inventory Estimates in Selected Double-Shell Tank Waste Types*, (internal letter 7E360-94-007 to D. J. Washenfelder, September 20), Westinghouse Hanford Company, Richland, Washington.

- Contains chemical composition estimates for PFP waste.

Van der Cook, R. E., 1968, *Flowsheets For Treating Z Plant Aqueous and Organic Wastes Prior To Tank Farm Storage and Concentration*, ARH-266, Atlantic Richfield Hanford Company, Richland, Washington.

- Document gives Z Plant aqueous salt and organic waste compositional treatment flowsheets prior to transfer to tank farms.

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

IIIa. Inventories using both Campaign and Analytical Information

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains waste type summaries, primary chemical compound/analyte and radionuclide estimates for sludge, supernatant, and solids, as well as SMM, TLM, and individual tank inventory estimates.

Agnew, S. F., R. A. Corbin, J. Boyer, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, B. L. Young, R. Anema, and C. Ungerecht, 1996, *History of Organic Carbon in Hanford HLW Tanks: HDW Model Rev. 3*, LA-UR-96-989, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Attempts to account for the disposition of soluble organics and provides estimates of TOC content for each tank.

Brevick, C. H., J. L. Stroup, and J. W. Funk, 1997, *Historical Tank Content Estimate for the Southeast Quadrant of the Hanford 200 East Area*, WHC-SD-WM-ER-350, Rev. 1B, Fluor Daniel Northwest Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains summary information for tanks in AN, AP, AW, AY, AZ, and SY tank farms as well as in-tank photo collages and inventory estimates.

Kupfer, M. J., A. L. Boldt, and M. D. LeClair, 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains a global component inventory for major constituents in 200 East and West Areas waste tanks.

Jones, T. E., R. T. Winward, and M. J. Kupfer, 1997, *Tank Characterization Report for Double-Shell Tank 241-SY-102*, WHC-SD-WM-ER-366, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Contains best-basis inventory for tank 241-SY-102.

Schmittroth, F. A., 1995, *Inventories for Low-Level Tank Waste*, WHC-SD-WM-RPT-164, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains a global inventory based on process knowledge and radioactive decay estimations using ORIGEN2. Pu and U waste contributions are taken at 1 percent of the amount used in processes. Also compares information on ^{99}Tc from both ORIGEN2 and analytical data.

IIIb. Compendium of Existing Physical and Chemical Documented Data Sources

Agnew, S. F., and J. G. Watkin, 1994, *Estimation of Limiting Solubilities for Ionic Species in Hanford Waste Tank Supernatants*, LA-UR-94-3590, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Gives solubility ranges used for key chemical and radionuclide components based on supernatant sample analyses.

Brevick, C. H., J. L. Stroup, and J. W. Funk, 1997, *Supporting Document for the Southeast Quadrant Historical Tank Content Estimate Report for SY Tank Farm*, WHC-SD-WM-ER-319, Rev. 1B, Fluor Daniel Northwest Inc., Richland, Washington.

- Contains summary information for tanks in the SY Tank Farm as well as appendices containing more detailed information, including tank waste level history, tank temperature history, cascade and dry well charts, riser information, in-tank photo collages, and tank layer model bar chart and spreadsheet.

Brevick, C. H., L. A. Gaddis, and E. D. Johnson, 1996, *Tank Waste Source Term Inventory Validation, Vol I, II, and III*, WHC-SD-WM-ER-400, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Contains a quick reference to sampling information in spreadsheet or graphical form for 24 chemicals and 11 radionuclides for all the tanks.

Colburn, R. P., 1995, *Identification of Potential Transuranic Waste Tank at the Hanford Site*, WHC-SD-WM-ES-331, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains TRU and HLW definitions as applied to a few tanks including tank 241-SY-102.

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- Contains account of waste transfers for double-shell tanks, including waste type and volume, source, and destination.

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- Contains selected sample analysis tables prior to 1993 for double-shell tanks.

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